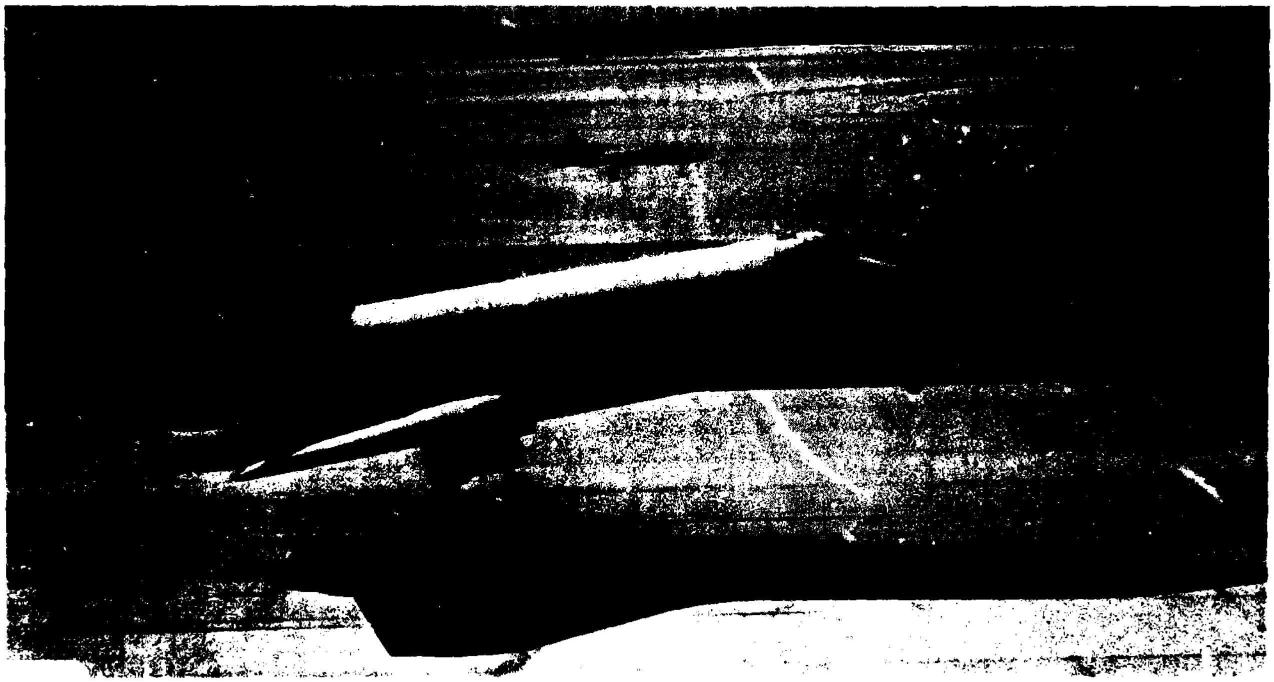
(1)

AD-A157 590

PHASE IV - INSTALLATION RESTORATION PROGRAM (SITES 1,2,3,4,5,8,13)

REMEDIAL ACTION PLAN AND CONCEPTUAL DOCUMENTS

EDWARDS AFB, CALIFORNIA



PREPARED FOR

U.S. ARMY CORPS OF ENGINEERS
MISSOURI RIVER DIVISION
OMAHA DISTRICT
Omaha, Nebraska

ES ENGINEFRING-SCIENCE

(1)

INSTALLATION RESTORATION PROGRAM
PHASE IV: REMEDIAL ACTION PLAN
AND CONCEPTUAL DOCUMENTS
Edwards AFB, California

Prepared For

U.S. ARMY CORPS OF ENGINEERS
MISSOURI RIVER DIVISION
OMAHA DISTRICT
Omaha, Nebraska

DACA 45-85-C-0065

November 1984

Prepared By

ENGINEERING-SCIENCE
57 Executive Park South, Suite 590
Atlanta, Georgia 30329
and
125 West Huntington Drive
Arcadia, California 91006

This report has been prepared for the United States Army Corps of Engineers by Engineering-Science for the purpose of aiding in the implementation of the Air Force Installation Restoration Program. It is not an endorsement of any product. The views expressed herein are those of the contractor and do not necessarily reflect the official views of the United States Army Corps of Engineers, the United States Air Force or the Department of Defense.

Accession For
NTIS GRA&I
DTIC TAB
Unannounced
Justification Per Form 50
By
Distribution/
Availability Codes
Dist	Avail and/or Special
A-1	

ES ENGINEERING-SCIENCE

125 WEST HUNTINGTON DRIVE • P. O. BOX 538 • ARCADIA, CALIFORNIA 91006 • 818/445-7560

CABLE ADDRESS ENGINSCI
TELEX 67-5428

November 30, 1984

Mr. Paul Dappen
U.S. Army Corps of Engineers
Omaha District
MROED-S
215 North 17th Street
Omaha, NB 69102

Dear Paul:

Enclosed is the final report entitled <u>Phase IV - Installation Restoration Program (Sites 1, 2, 3, 4, 5, 8, and 13) Remedial Action Plan and Conceptual Documents - Edwards AFB</u> prepared under Contract No. ~~F08637-83-G0005.~~ This report incorporates the comments from the review meeting held in Atlanta, Georgia on June 21, 1984, and the written comments received on September 27, and November 21, 1984.

It has been a pleasure working on the project with both the U.S. Army COE and the U.S. Air Force. We look forward to a continued excellent working relationship.

Sincerely,

Gary Christopher

W. G. Christopher, P.E.
Project Manager

WGC:at
Enclosure

TABLE OF CONTENTS

	LIST OF TABLES AND FIGURES	
	EXECUTIVE SUMMARY	1
	Approach to Problem	2
	Descriptions of Sites Involved in Study	3
	Selection of Preferred Alternatives	5
	Recommended Remedial Actions	6
SECTION 1	INTRODUCTION	1-1
	Introduction	1-1
	The Installation Restoration Program (IRP)	1-1
	Summary of Phases I, II and III Activities at Edwards AFB	1-3
	Phase IV Site Descriptions	1-4
	Objective of Remedial Action	1-19
	Methodology	1-19
SECTION 2	IDENTIFICATION AND PRELIMINARY SCREENING OF REMEDIAL ACTION ALTERNATIVES	2-1
	Introduction	2-1
	Identification of Remedial Action Alternatives	2-2
	Preliminary Screening Criteria	2-6
	Preliminary Screening of Remedial Action Alternatives (Secondary Screening)	2-8
SECTION 3	DETAILED ANALYSIS OF PREFERRED REMEDIAL ACTION ALTERNATIVES	3-1
	Introduction	3-1
	Site 1 - North Lake Bed Disposal and Storage Site	3-1
	Site 2 - Main Base Waste Disposal Site	3-22
	Site 5 - South Base Underground Waste POL Storage Tanks	3-37
	Summary of Preferred Alternatives Analysis	3-48

TABLE OF CONTENTS (continued)

SECTION 4	RECOMMENDED REMEDIAL ACTION FOR EACH SITE	4-1
	Introduction	4-1
	Site 1 - North Lake Bed Disposal and Storage Site	4-1
	Site 2 - Main Base Waste Disposal Site	4-2
	Site 5 - South Base Underground Waste POL Storage Tanks	4-3
	Other Sites (3, 4, 8, and 13)	4-4
SECTION 5	CONCEPTUAL DOCUMENTS FOR REMEDIAL ACTION AT SITES 1, 2 AND 5	5-1
	Introduction	5-1
	Description of Remedial Actions	5-1
	List of Specifications	5-5
	List of Drawings	5-5
	Implementation Schedule	5-5
	Monitoring and Maintenance Requirements	5-5
	Additional Design Engineering Data Requirements	5-10
	Preliminary Cost Estimate	5-11
APPENDIX A	BIOGRAPHICAL DATA ON PROJECT TEAM PERSONNEL	
APPENDIX B	GLOSSARY	
APPENDIX C	CONTRACT WASTE DISPOSAL SITES	
APPENDIX D	ENVIRONMENTAL IMPACT ANALYSIS DOCUMENTATION (Prepared by AFFTC)	
APPENDIX E	HEALTH, SAFETY, AND EMERGENCY RESPONSE SPECIFICATION FOR RECOMMENDED REMEDIAL ALTERNATIVES	
APPENDIX F	MONITORING PROGRAM	
APPENDIX G	AIR FORCE DOCUMENTATION PLAN	
APPENDIX H	CHEMICAL ANALYTICAL PLAN	
APPENDIX I	SUPPLEMENTAL PHASE IV SITE CHARACTERIZATION DATA FOR SITES 1 AND 2	
APPENDIX J	REFERENCES	
APPENDIX K	MAILING LIST FOR FINAL REMEDIAL ACTION PLAN	
APPENDIX L	FEDERAL, STATE AND LOCAL AGENCY COMMENTS RECEIVED ON FINAL REMEDIAL ACTION PLAN	

LIST OF TABLES

1.1	Site 1 - Nature and Depth of Contamination	1-10
2.1	Potential Remedial Action Alternatives	2-3
2.2	Evaluation of Potential Remedial Action Alternatives - Subsite 1A	2-9
2.3	Evaluation of Potential Remedial Action Alternatives - Subsites 1B, 1D, 1E	2-10
2.4	Evaluation of Potential Remedial Action Alternatives - Subsite 1C	2-12
2.5	Evaluation of Potential Remedial Action Alternatives - Site 2	2-13
2.6	Evaluation of Potential Remedial Action Alternatives - Site 5	2-14
3.1	Site 1 - Preferred Remedial Action Alternatives	3-2
3.2	Summary of Permits and Regulations - Phase IV IRP	3-10
3.3	Comparison of Soil Contaminant Concentrations with Various Available Toxicity Indicators	3-12
3.4	Recommended Guidelines for Future Land Use Restrictions at Site 1	3-18
3.5	Description of Guidelines for Land Use Restrictions	3-19
3.6	Site 1 - Health and Safety Requirements for Remedial Action Alternatives	3-20
3.7	Site 1 - Estimated Costs for Remedial Action Alternatives	3-23
3.8	Summary of Site 1 Preferred Alternatives Environmental Monitoring	3-24
3.9	Site 2 - Preferred Remedial Actions	3-25
3.10	Recommended Guidelines for Future Land Use Restrictions at Site 2	3-35
3.11	Site 2 - Health and Safety Requirements for Remedial Action Alternatives	3-36
3.12	Site 2 - Estimated Costs for Remedial Action Alternatives	3-38
3.13	Site 5 - Preferred Remedial Action Alternatives	3-39
3.14	Site 5 - Health and Safety Requirements for Remedial Action Alternatives	3-44
3.15	Recommended Guidelines for Future Land Use Restrictions at Site 5	3-45
3.16	Site 5 - Estimated Costs for Remedial Action Alternatives	3-47
5.1	List of Specifications	5-6
5.2	List of Drawings	5-7
5.3	Preliminary Cost Estimates for Recommended Remedial Actions	5-12

LIST OF FIGURES

1.1	Known Past and Current Disposal and Storage Areas	1-5
1.2	Sites 1A and 1E	1-8
1.3	Sites 1B, 1C and 1D	1-9
1.4	Relative Location of Waste Pits Based on Magnetometer Survey - Site 2	1-12
1.5	Layout of Site 5	1-14
1.6	Abandoned Sanitary Landfill (Site 3)	1-16
1.7	Sanitary Landfill (Site 4)	1-17
1.8	Industrial Waste Pond (Site 8)	1-18
1.9	Rocket Propulsion Laboratory Sanitary Landfill (Site 13)	1-20
1.10	Phase IV Edwards AFB Remedial Action Methodology	1-21
3.1	Monitoring Well Design for Sites 1A, 1B, 1C, 1D and 1E	3-6
3.2	Lysimeter Design for Site 2	3-26
3.3	Location of Proposed Monitoring Wells, Site 5	3-40
3.4	Monitoring Well Design for Site 5	3-41
5.1	Remedial Action Construction Schedule	5-8

EXECUTIVE SUMMARY

The Department of Defense (DOD) has developed a program to identify and evaluate past hazardous material disposal sites on DOD property to control the migration of hazardous contaminants and to control hazards to health or welfare that may result from these past disposal operations. This program is called the Installation Restoration Program (IRP). The IRP has four phases consisting of Phase I, Initial Assessment/Records Search; Phase II, Confirmation/Quantification; Phase III, Technology Base Development; and Phase IV, Operations/Remedial Actions.

The Phase I activities at Edwards, completed in 1981, identified nine potential sites (i.e., Sites 1 through 9) of concern. Upon evaluation, four of these nine sites were eliminated from consideration as having no potential to contaminate surface water or subsurface aquifers. The Phase II - Stage 1 study, completed in September 1982, evaluated the remaining five of the original nine sites in addition to two sites (i.e., Sites 10 and 11) identified at the completion of the Phase I effort. A Phase II - Stage 2 report, completed August 1984, further investigated Sites 1, 2, 3, 4, 5, and 8. Due to new emphasis by the State of California on active landfills and fire training pits as well as information obtained from the Phase II - Stage 1 and Stage 2 field investigations, five additional sites (i.e., Sites 12, 13, 14, 15, and 16) were added bringing the total to twelve. The initial Phase II (i.e., Stage 1 and Stage 2) investigations then evaluated Sites 1, 2, 3, 4, 5, 8, 10, and 11. Sites 1, 2, and 5 were identified as having the greatest potential to contaminate ground waters. Phase IV remedial actions were begun for these sites in April 1984. Follow-on Phase II (Stage 3) efforts, will begin in 1985 to further evaluate Sites 5, 10, and 11 and begin studies for Sites 12, 14, 15, and 16.

The objective of this Phase IV project is to prepare and implement the remedial action plan primarily for Sites 1 (including Subsites 1A,

1B, 1C, 1D, and 1E), 2 and 5. Phase II - Stage 3 activities are ongoing at Sites 5, 10, 11, 12, 14, 15, and 16. Several of these sites may require remedial action(s) and will be addressed in a subsequent Phase IV report. This document presents the feasibility study and the remedial action plan for the preferred alternatives at Sites 1, 2, and 5, and includes the concept design documents. Based on the Phase II investigations and recommendations, the remedial actions at Sites 3, 4, 8, and 13 consist of installing monitoring wells or lysimeters as determined by specific site conditions. Hence, no remedial action plan (i.e., Phase IV-A) was prepared for these sites. Finally, this document serves as the environmental assessment for the proposed remedial actions. Conclusions and statements made in this report are based on data contained in Phase I, Phase II, and on supplemental information obtained in Phase IV.

APPROACH TO PROBLEM

The Phase IV activities are subdivided into two major efforts. Phase IV-A is identification and evaluation of possible remedial actions, resulting in the selection of the recommended action for each site. Phase IV-B consists of designing and implementing the recommended remedial actions. This report is limited to Phase IV-A for Sites 1, 2, and 5 and includes the following major elements:

- Identification and Preliminary Screening of Remedial Actions
- Detailed Analysis of Preferred Remedial Actions
- Selection of Recommended Remedial Action
- Preparation of Remedial Action Plan
- Preparation of Concept Documents

As a part of the overall Phase IV-A, it was necessary to perform sampling and analyses efforts supplemental to the original Phase II effort. This data included soil samples (surficial and below surface), drum content samples, and limited geophysical measurements. Results of this work are presented in Appendix I.

DESCRIPTION OF SITES INVOLVED IN STUDY

There are eleven sites involved in this study, the five subsites of Site 1, plus Sites 2, 5, 3, 4, 8, and 13. All the sites are in relatively remote locations on the base except Site 8 which is located adjacent to the flight line. There is very little shallow ground water and virtually no surface water at these sites due to the very low rainfall, minimal ground water recharge, and high evaporation rate. The nearest producing water wells range in distance from about one-quarter to three miles from the sites. Base and civilian populations are located more than a mile from Sites 1, 5, and 8, and about half a mile from Sites 2, 3, and 4. Levels of contamination in the soil are low and no contamination of ground water, either deep or shallow, has been detected at Sites 1, 2, 3, 4, 8, and 13. Migration of chemical substances has occurred into the underlying soils from Sites 1 and 2 although very little lateral migration has been detected. The risk to public health due to migration of contaminants from the sites is low.

There is evidence of contamination of the shallow aquifer with leaded fuels about one-half mile north of Site 5. This contamination is believed to be from another source based on hydrogeological conditions known as of the date of this report. However, Phase II investigations are being continued to confirm the source of this contamination.

Following is a brief description of the sites.

Site 1 - North Lake Bed Disposal and Storage Site

Site 1 includes five subsites used for a variety of waste disposal operations, primarily by the Air Force Rocket Propulsion Laboratory (AFRPL) and other North Base facilities. Subsite 1A is an open trench 20 feet wide, 10 feet deep and 60 feet long in which thirteen 55-gallon drums of motor oil and solvent had been dumped along with other metal debris. The drums were found to contain petroleum and oils, but no PCBs, and have already been removed to the Defense Property Disposal Office (DPDO) and salvaged. Companion Subsite 1E is an adjacent shallow trench containing metal debris and scattered empty metal drums. Subsite 1B contains ninety-seven 55-gallon drums sitting on pallets on the edge of a dry lake bed; forty of these drums contain liquid. Subsite 1C

includes three shallow earth basins in which nitric acid was dumped and flushed into the soil with water. Subsite 1D consists of two large trenches containing approximately seven hundred 55-gallon drums. During disposal operations in the mid 1960s, contents of the drums were poured into a shallow metal pan and ignited. The empty drums were then dumped into one of the trenches with the bungs removed.

Site 2 - Main Base Waste Disposal Site

Site 2 is an area of approximately 14 acres that was used for disposal of waste chemical solutions from the base plating shop, miscellaneous fuels, and fuel filters. The site was used from 1956 to the early 1960s and is within a mile of the Main Base area. The terrain slopes gently to the southeast towards Rogers Lake. The site is fenced and signs have been posted throughout the area indicating the location of buried chromate, cyanide, nitric acid, tetraethyl lead, hydrogen peroxide and fuels. Geophysical testing with magnetometer and resistivity equipment indicated that wastes were dumped directly into shallow trenches and that no drums were buried on the site. Soil analyses showed generally low levels of total chrome, lead and nitrates, and no cyanide or hexavalent chromium above detection limits.

Site 3 - Abandoned Sanitary Landfill

Site 3 is a closed Class II-2 landfill. The landfill was the active Main Base landfill from the mid 1960s until 1976 when the present Main Base landfill was opened.

Site 4 - Main Base Sanitary Landfill

Site 4 is the active Main Base Class II-2 sanitary landfill. The landfill was opened in 1976. The site is a cut-and-fill type operation which consists of refuse disposal trenches, a construction waste pit, and a waste pit for "infectious" type wastes such as syringes and bandages resulting from medical activities.

Site 5 - South Base Underground Waste Petroleum, Oils and Lubricants (POL) Storage Tanks

This site contains five underground 50,000-gallon capacity steel tanks, each encased in concrete. These tanks were installed in 1942, and were used for aviation gasoline storage until 1955. From 1972 to

the present, three of the tanks have been used to store waste jet fuels and engine oils. One of the tanks is reported to have leaked, but the quantity lost is unknown. This tank has been emptied and is no longer used. Topography is flat with sandy soils and very little sign of surface drainage. Even though the site is remote from most of the Main Base activities, it is completely fenced and the gate is kept locked. The site covers approximately one acre.

Site 8 - Industrial Waste Pond

Site 8 is the storm water containment pond which collects storm waters diverted into the storm water system from along the flight line. The pond also receives small quantities of wastes (such as oils) from several aircraft hanger floor drains.

Site 13 - Air Force Rocket Propulsion Laboratory Sanitary Landfill

Site 13 is the active Class II-2 sanitary landfill at the Air Force Rocket Propulsion Laboratory. The landfill is used for disposal of commercial and construction wastes.

SELECTION OF PREFERRED ALTERNATIVES

A two-tiered selection process was used to first narrow a field of 18 candidate remedial technologies to approximately eight for each of the Sites 1, 2, and 5. These were then evaluated in terms of five key criteria: technical applicability, environmental impact, public health risk, regulatory compliance/acceptability, and cost. This process is summarized in Section 2.

Installation of monitoring wells was recommended for Sites 3, 4, and 8 in the Phase II report. Wells at Site 13 were added due to new standards promulgated by the Water Quality Control Board (WQCB). This recommendation is being implemented as a Phase IV action. Sites 3, 4, 8, and 13 were not subjected to the two-tiered selection process described above.

The preferred alternatives list included three principal alternatives for Site 1, four alternatives for Site 2, and four for Site 5. Each of the sites included an alternative called "Monitoring/Site

Maintenance" that included strengthening the sites' security, installing monitoring wells to detect any migration of contaminants, controlling surface water run on and run off, and maintenance of site facilities. No further remedial actions are included with this alternative. Typical of other alternatives is the removal of contaminated soil, waste drums, or tanks; construction of barrier walls or other impermeable barriers; and construction of clay caps and synthetic liners to minimize/eliminate the infiltration of water which could mobilize contaminants.

These preferred alternatives were then evaluated in detail in Section 3. This involved analysis of each alternative in ten important areas including engineering, environmental impacts, cost, health and safety, and regulatory aspects. From these rankings, the recommended remedial action for each site was selected.

RECOMMENDED REMEDIAL ACTIONS

Based on the evaluations in this Phase IV-A document, the following are the recommended remedial actions for Sites 1, 2, and 5. Each of these sites has been drawn on the Edwards AFB Master Plans. It should be emphasized that the use of local playa as a clay cap at Subsites 1C and 1D is recommended due to local availability of the playa and not necessarily because of an engineering requirement.

Subsite 1A - Motor Oil Disposal Trench

- Excavate remaining debris and associated surface soils and haul to the Main Base sanitary landfill or to a secure contract landfill depending on soil sampling and analysis results
- Backfill the depression and grade to natural contours

Subsite 1B - Drum Storage

- Sample drums containing liquid and conduct compatibility testing for liquid waste bulking and shipping purposes
- Haul liquids to a secure Class I contract disposal site
- Steam clean empty drums and dispose of drums at the Main Base sanitary landfill
- Haul drum residuals to a secure Class I contract disposal site

Subsite 1C - Nitric Acid Pits

- Place a cap over each of the three individual pits
- Install a fence around Subsites 1C and 1D.

Subsite 1D - Drum Trenches

- Sample drums containing liquid
- Haul drums containing liquid to a secure Class I contract disposal site
- Clean empty drums, crush and dispose of at the Main Base sanitary landfill
- Excavate associated surface debris and haul to a secure contract disposal site
- Backfill trenches with local soil and grade to natural contours
- Place a cap over each of the trenches
- Install fence around Subsites 1C and 1D

Subsite 1E - Debris Dump

- Remove debris and haul to the Main Base sanitary landfill
- Grade to natural contours

These remedial actions also include the installation of two monitoring well systems consisting of one up-gradient and three down-gradient wells for ground-water sampling at combined Subsites 1A and 1E, and one up-gradient and four down-gradient wells at combined Subsites 1B, 1C, and 1D. Wells are to be monitored for the procedures described in Appendix F of this document.

Site 2 - Main Base Waste Disposal Site

- Construct an up-gradient swale to divert run on
- Install one up-gradient and two additional down-gradient lysimeters and initiate long-term monitoring
- Remove surface debri and dispose of in Main Base sanitary landfill
- Fill in the trenches with local soil and return the trench area to grade

Site 5 - South Base Underground Waste POL Storage Tanks

- Remove waste POL from the tanks and dispose of through a secure Class I contract disposal site
- Clean the tanks and dispose of residue in a secure Class I contract disposal site
- Fill tanks with local sand
- Backfill and grade to natural contours
- Install three additional monitoring wells down gradient and one up gradient in the deep aquifer and initiate long-term monitoring

Based on the Phase II investigations and recommendations, the following are the selected remedial actions for Sites 3, 4, 8, and 13. Lysimeters are to be installed at Sites 3, 4, and 13 in lieu of monitoring wells due to the lack of permanent subsurface aquifers. However, transient shallow water occurs following heavy rainfall and lysimeters are the most appropriate means to sample this soil moisture and seasonal shallow water. Monitoring procedures/schedules are described in Appendix F.

Site 3 - Abandoned Sanitary Landfill

- Install one up-gradient and three down-gradient lysimeters

Site 4 - Main Base Sanitary Landfill

- Install one up-gradient and two down-gradient lysimeters

Site 8 - Industrial Waste Pond

- Install one up-gradient and three down-gradient monitoring wells

Site 13 - Air Force Rocket Propulsion Laboratory Sanitary Landfill

- Install one up-gradient and two down-gradient lysimeters

SECTION 1

INTRODUCTION

1.0 INTRODUCTION

The purpose of this section is to provide background information on previous IRP activities and an overview of the Phase IV program at Edwards AFB. The relationship of Phase IV to the other phases of the IRP, descriptions of each of the sites at Edwards, and the objectives and approach of this program are all presented.

1.1 THE INSTALLATION RESTORATION PROGRAM (IRP)

The U.S. Air Force (USAF), due to its primary mission of national defense, has necessarily engaged in a wide variety of operations dealing with materials of a toxic or hazardous nature. This problem has been recognized by DOD and action has been taken to identify the locations and contents of past disposal sites and eliminate the hazards to public health in an environmentally responsible manner. The USAF IRP is a four-phased program designed to assure that identification, confirmation/quantification, and remedial actions are performed in a timely, cost-effective, and environmentally responsible manner. The Installation Restoration Program Phase IV Management Guidance Manual used in preparing this document was developed by the Air Force Engineering Services Center (AFESC) at Tyndall AFB, Florida. Each phase and its relationship to the overall program are briefly described below.

1.1.1 Phase I - Initial Assessment/Records Search

Phase I identifies and prioritizes past disposal sites that may pose a hazard to public health or the environment as a result of contaminant migration. Sites are eliminated from further IRP activities if

they pose no significant environmental/public health threat. Identification is accomplished through the review of all available environmental records for the facility, surface surveys, literature surveys for geological and hydrogeological data and interviews with former and current workers. In this phase, it is determined whether a site requires further action to confirm an environmental hazard. If a site requires immediate remedial action (e.g., removal of abandoned drums because of known contamination), the action can proceed directly to Phase IV, omitting Phase II. Phase I is the basic background document for the Phase II study.

1.1.2 Phase II - Confirmation/Quantification

Phase II further defines and quantifies, by environmental and/or ecological surveys, the presence and extent of contamination. Sites are identified where remedial action is required. Research requirements identified during this phase are directed to the AFESC for inclusion in the Phase III portion of the program. Needs for contaminant health standards are identified and submitted to the Command Surgeon for resolution. For Edwards AFB, Phase II will be divided into at least 3 stages.

1.1.3 Phase III - Technology Base Development

This phase is to research and develop state-of-the-art technologies for cleaning up or containing hazardous wastes. Requirements for this R&D work may be identified during other phases of the IRP and are submitted to AFESC at Tyndall AFB for investigation.

1.1.4 Phase IV - Operations/Remedial Actions

Phase IV involves the identification and evaluation of remedial action alternatives. A preferred remedial action is then selected. This includes preparation of a remedial action plan, design drawings and specifications. The design drawings and specifications serve as the statement of work for the actual cleanup conducted during Phase IV-B.

1.2 SUMMARY OF PHASES I, II AND III ACTIVITIES AT EDWARDS AFB

The Phase I study, completed in 1981, assessed the potential for ground-water contamination at Edwards AFB. Nine waste disposal sites were identified and evaluated in the Phase I report. These included Sites 1, 2, 3, 4, 5, 6, 7, 8, and 9. Based on the Phase I evaluation, four sites (i.e., Site 4, 6, 7, and 9) were eliminated as having no potential for environmental contamination. Five of the nine sites (Sites 1, 2, 3, 5, and 8) were subsequently investigated in Phase II as were two new sites (Sites 10 and 11) added after Phase I was completed. Five additional sites (i.e., Sites 12, 13, 14, 15, and 16) were added at the completion of the Phase II - Stage 2 investigation. Edwards IRP sites now total 16 of which 13 are undergoing Phase II investigation or some type of Phase IV remedial action. These 13 sites include abandoned drum storage areas and drum trenches (Subsites 1A, 1B, and 1D); acid pits (Subsite 1C); an abandoned hazardous waste dump (Site 2); an abandoned sanitary landfill (Site 3); underground waste POL storage tanks (Site 5); a storm water pond used to control flight line wash water and runoff (Site 8); a jet fuel pipeline leak that occurred in the early 1970s (Site 10); a jet fuel hydrant leak that occurred in the mid 1970s (Site 11); a debris disposal area (Subsite 1E); two active landfills (Sites 4 and 13); a trichloroethylene containment pond (Site 12); a JP-4 spill discovered in 1983 (Site 16); fire training pit (Site 14); and Site 15 which encompasses the entire South Base area.

The purpose of Phase II at Edwards was to:

- Determine the extent and magnitude of environmental contamination resulting from previous waste disposal practices
- Recommend remedial measures
- Develop a monitoring program to document environmental conditions resulting from past waste disposal activities

To accomplish these tasks, the initial Phase II program included the installation of 14 ground-water monitoring wells and two lysimeters, completion of 11 soil borings for collection of subsurface soil samples, and the collection of surface soil samples. The Phase II report discussed development and implementation of the field program, sampling

procedures, data analyses, conclusions, and recommendations for future actions and monitoring.

Based on the results of the Phase I and II work, the Air Force decided to proceed to Phase IV for Sites 1A, 1B, 1C, 1D, 1E, 2, and 5. Remedial actions consisting of installation/monitoring of lysimeters or wells were recommended in the Phase II document for Sites 3, 4, 8, and 13. These actions were reviewed and concurred by State and County Regulatory Agencies. Because of this concurrence and because the remedial actions chosen had no practical alternatives, these actions at Sites 3, 4, 8, and 13 were not analyzed in depth in this document. Phase II (Stage 3) investigations are continuing at Sites 5, 10, 11, 12, 14, 15, and 16.

Phase III activities included contacting AFESC, alerting them to the planned remedial actions, and discussing future R&D efforts in the area of biological treatment of subsurface soils contaminated with fuels and oils. AFESC is presently conducting Phase III R&D at several bases; Edwards has been identified as one potential installation for specific future R&D investigations.

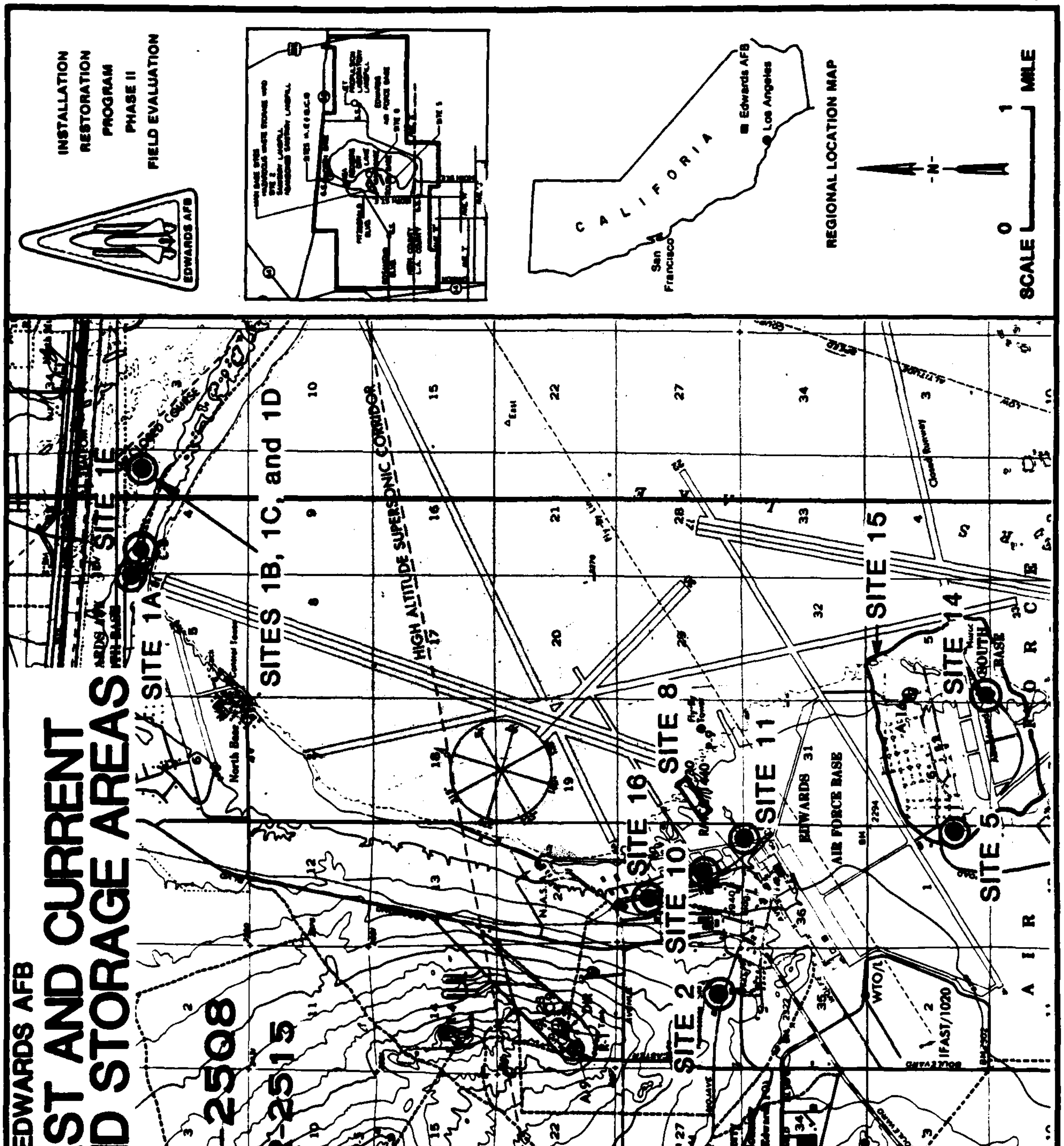
1.3 PHASE IV SITE DESCRIPTIONS

Three primary sites are included in this Phase IV work:

- Site 1 - North Lake Bed Disposal and Storage Site
  - Subsite 1A. Motor Oil Drum Disposal Trench
  - Subsite 1B. Drum Storage
  - Subsite 1C. Nitric Acid Pits
  - Subsite 1D. Drum Trenches
  - Subsite 1E. Debris Disposal Area
- Site 2 - Main Base Waste Disposal Site
- Site 5 - South Base Underground Waste Petroleum, Oil and Lubricants (POL) Storage Tanks

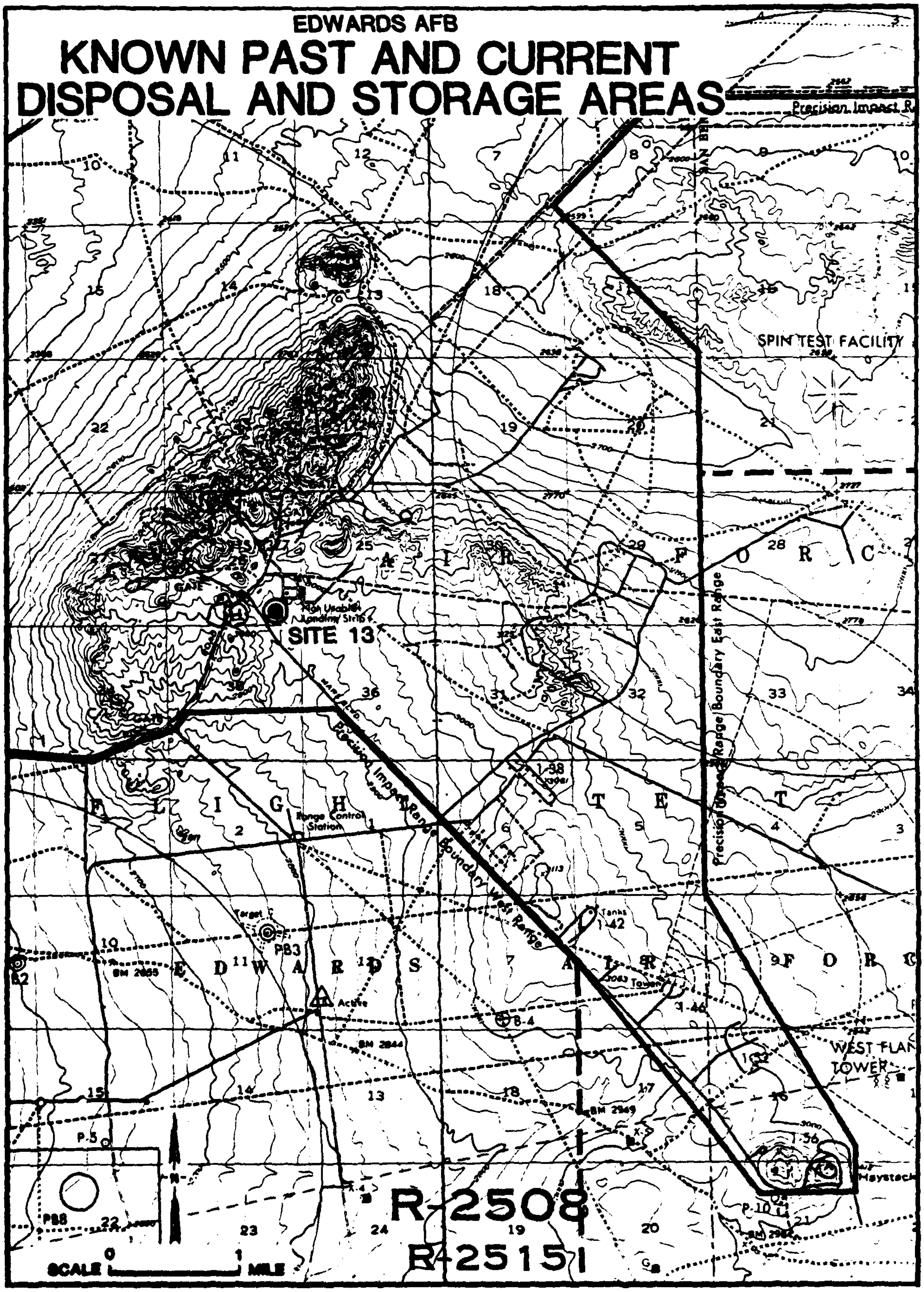
Figure 1.1 shows the locations of these three sites in addition to Sites 3, 4, 8, and 13. An overview of each of the primary sites is provided below.

FIGURE 1.1



ES ENGINEERING-SCIENCE

FIGURE 1.1 (cont'd)



ENGINEERING-SCIENCE

1.3.1 Site 1 - North Lake Bed Disposal and Storage Site

1.3.1.1 Description

Site 1 includes several subsites used for a variety of waste disposal operations, primarily by AFRPL (see Figures 1.2 and 1.3). Subsite 1A is an open trench roughly 20 feet wide, 10 feet deep and 60 feet long in which thirteen 55-gallon drums of motor oil were disposed with other metal debris. Judging by the good condition of the drums, the site is probably less than 10 years old. Companion Subsite 1E is an adjacent shallow trench containing metal and other debris, and some empty metal drums. Subsite 1B contains ninety-seven 55-gallon drums sitting on pallets on the edge of a dry lake bed. Most of the drums are empty, however forty do contain liquids most probably consisting of oil/water mixtures and light solvents. Subsite 1C includes three shallow earth basins in which nitric acid was dumped and flushed into the soil with water. Subsite 1D has two large trenches containing approximately 700 drums. During the period of site disposal operations (i.e., 1960s), contents of the drums were poured into a shallow metal pan and ignited. The empty drums were then put into one of the trenches.

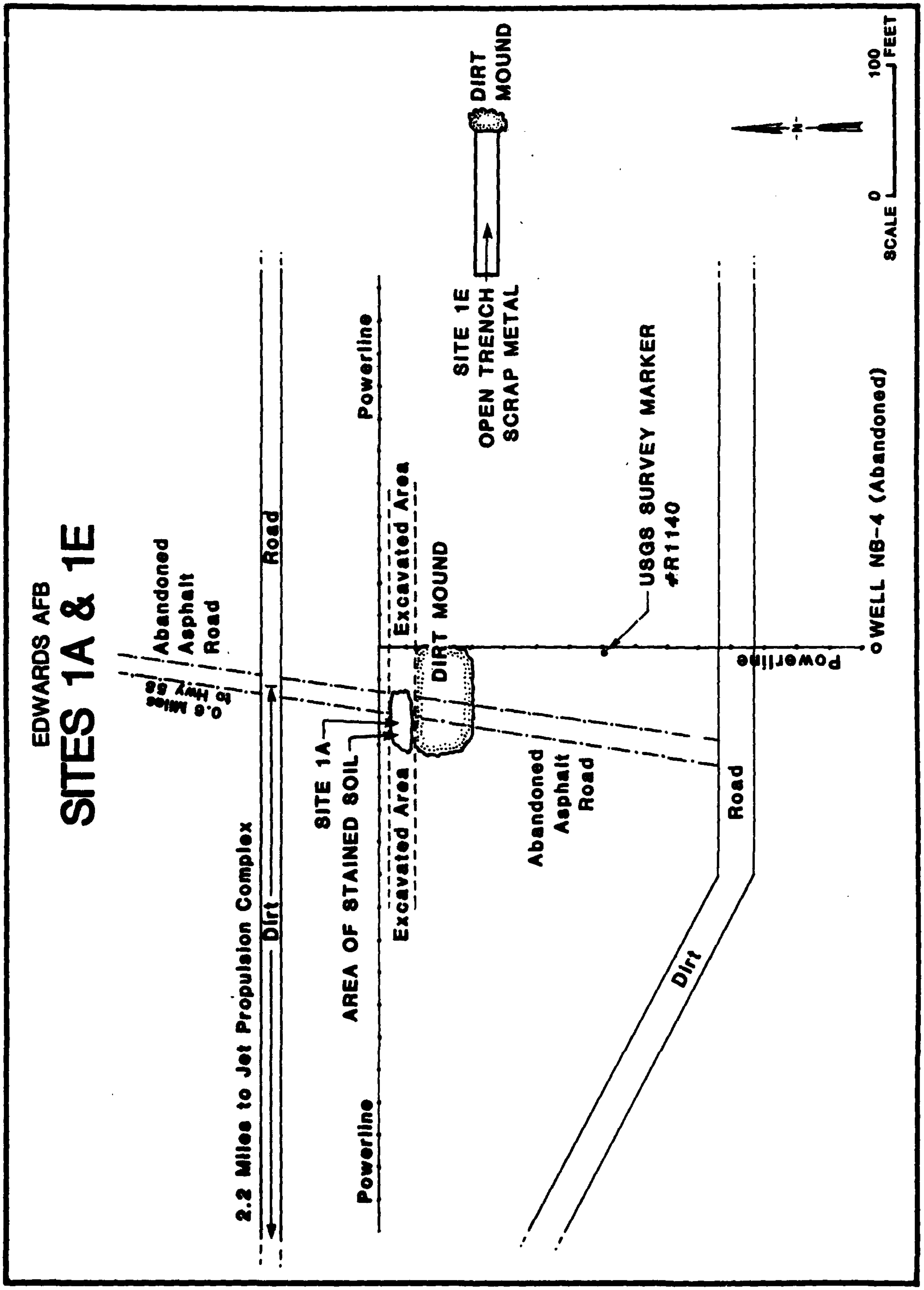
1.3.1.2 Environmental Setting

The cluster of sites comprising Site 1 are located at the extreme northern portion of the base. Soils range from sands and gravels to clays and are of generally low permeability (10^{-4} to 10^{-6} cm/sec). No permanent surface water exists as only four inches of rainfall and over 114 inches of evaporation occur per year on the average. Ground water is found at 135 feet below ground surface under geologically confined conditions. The ground-water gradient is to the northwest.

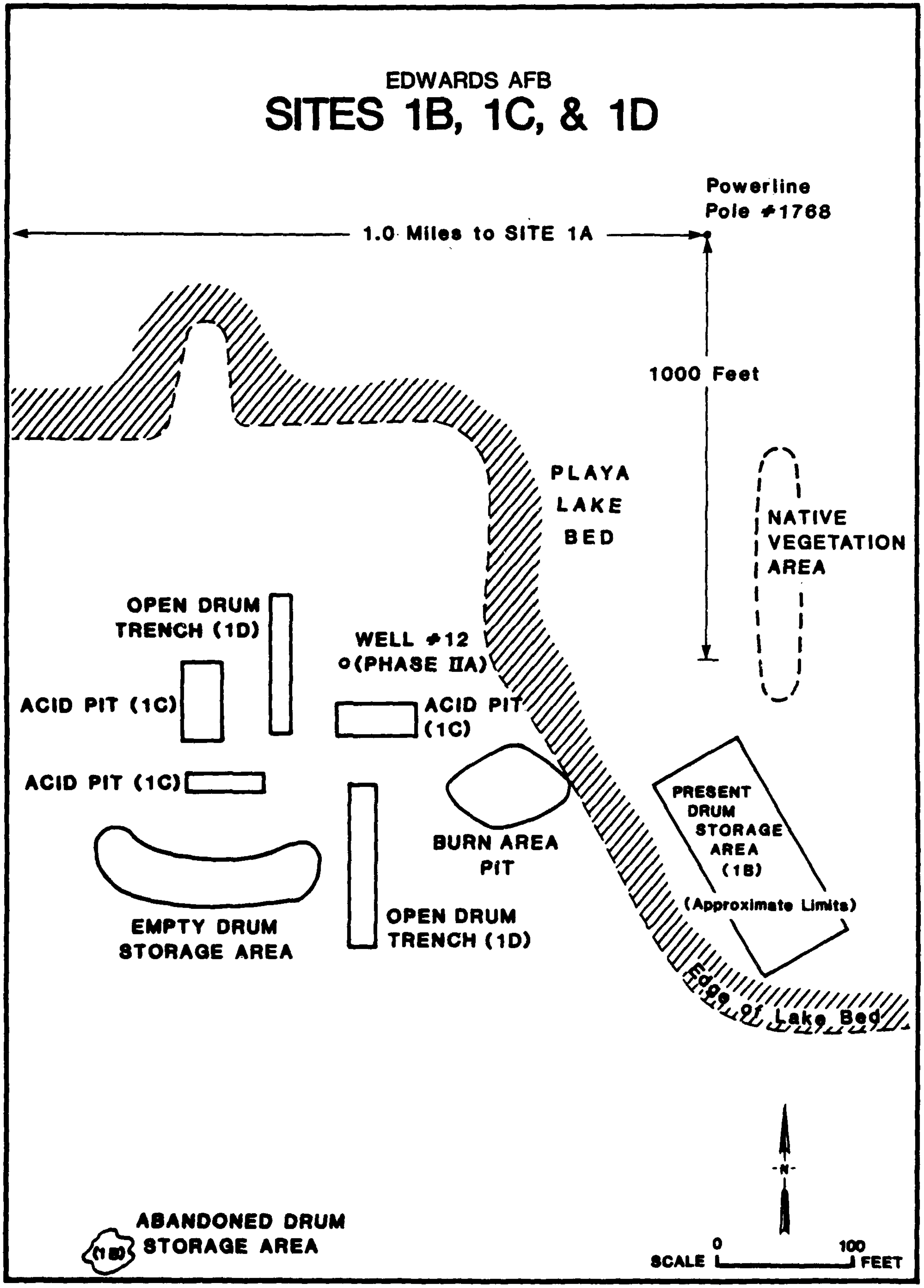
1.3.1.3 Nature and Extent of Contamination

Table 1.1 summarizes the types of contaminants and the extent of contamination for the subsites comprising Site 1. Chloroform and Freon 11 occur in low concentrations at Subsites 1A, 1B, and 1D. One explanation is that these compounds are present in the soil as gases, moving by diffusion through the interstitial spaces.

FIGURE 1.2



EDWARDS AFB
SITES 1A & 1E
2.2 Miles to Jet Propulsion Complex
0.6 Miles to Hwy 58
Abandoned Asphalt Road
Dirt
Road
Powerline
SITE 1A
AREA OF STAINED SOIL
Excavated Area
DIRT MOUND
SITE 1E
OPEN TRENCH
SCRAP METAL
DIRT MOUND
USGS SURVEY MARKER #R1140
WELL NB-4 (Abandoned)
N
SCALE
0
100
FEET



ES ENGINEERING-SCIENCE

TABLE 1.1

SITE 1
NATURE AND DEPTH OF CONTAMINATION

Subsite	Contaminants[a]	Extent[b]
1A	Motor oil, lube oil	• Smell of oil to 15-foot depth • Very low levels of chloroform and trichlorofluoromethane (Freon 11) to a depth of 65 feet
1B	Oils, solvents, alcohols, aniline	• Very low levels of chloroform and Freon 11 to a depth of 55 feet
1C	Nitric acid, nitrates	• Very low pH and high soil nitrate concentrations to a depth of 25 feet • Neutral pH and 965 mg/kg nitrate at 57 feet • No nitrate in ground water at 135 feet
1D	55-gallon drums which formerly contained volatile hydrocarbons, chlorinated hydrocarbons and possibly hydrazine (Most, if not all, drums are now empty.)	• Very low levels of chloroform and Freon 11 to a depth of 62 feet
1E	Metal debris	• No soil contamination

[a]Contaminants found in soil, not in ground water.
[b]See later in Section 1 for concentrations of contaminants.

1.3.1.4 Location of Receptors

Site 1 is the only site with the potential for off-base migration of contaminants, namely nitrates from Subsite 1C and volatile organics from Subsite 1D. Two active base water supply production wells are located near Site 1; one approximately one-half mile west of Subsite 1A and a second one about one-quarter mile southeast. The town of North Edwards is located about one mile north of the disposal sites. As previously mentioned, no contamination has been detected in the ground water below the sites, in nearby production wells, or in monitoring wells.

1.3.2 Site 2 - Main Base Waste Disposal Site

1.3.2.1 Description

Site 2 is an area of approximately 14 acres enclosed by a fence that was used for disposal of waste chemical solutions primarily from the base plating shop; however, miscellaneous fuels, and fuel filters from aircraft maintenance shops have also been disposed of at this site. The site was used from the mid 1950s to the early 1960s and is within one-half mile of the Main Base area. The terrain slopes gently to the southeast towards Rogers Lake. The site is fenced and signs have been posted throughout the area indicating buried chromate, cyanide, nitric acid, tetraethyl lead, hydrogen peroxide, and fuels. Recent geophysical testing with magnetometer and resistivity equipment indicated that wastes were dumped directly into shallow trenches and that drums were probably not buried on the site (see Appendix I). Figure 1.4 shows the site layout with all the disposal areas identified.

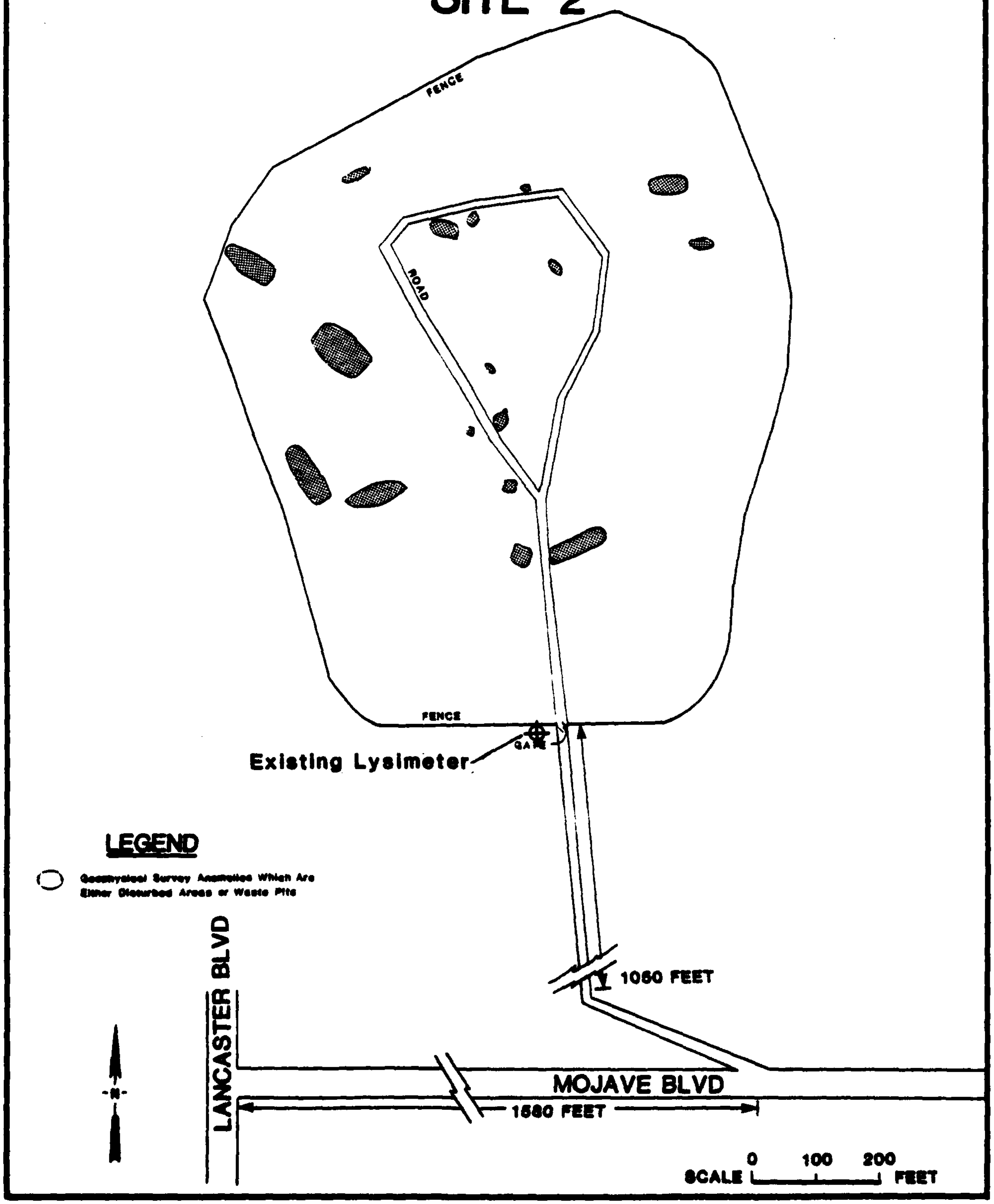
1.3.2.2 Nature and Extent of Contamination

At the time of the Phase II study, the possible presence of buried drums precluded extensive soil borings on site for safety reasons. One boring was drilled at the southern end of the site in one of the marked disposal trenches. Chromium in the 60 to 80 mg/kg range was found in the soil to a depth of 21 feet at bedrock. Tetraethyl lead was found in 1 to 2 mg/kg concentrations over the same depth. A lysimeter was installed to a depth of 10 feet just down gradient of the site to the south. No water has been detected in the lysimeter. No ground water

FIGURE 1.4

EDWARDS AFB

RELATIVE LOCATION OF WASTE PITS BASED ON MAGNETOMETER SURVEY SITE 2



was encountered at this site. However, transient water may occur seasonally as a result of local precipitation.

Results of Phase IV soil sampling throughout the site showed cyanide levels below the detectable limit of 0.1 mg/kg, chromium concentrations of 76 mg/kg and below, nitrate levels less than 20 mg/kg except one area at 93 mg/kg, and lead concentrations less than 10 mg/kg except one area at 41 mg/kg. Overall, the site had much lower concentrations than expected.

1.3.2.3 Location of Receptors

There is no permanent shallow ground water table at Site 2. The purpose of the lysimeter is to determine if seasonal ground water exists. The nearest producing aquifer is approximately 3,500 feet in a lateral direction along the bedrock. The distance to the nearest production well is approximately three miles. Bedrock is at 21 feet.

1.3.3 Site 5 - Underground Waste POL Storage Tanks

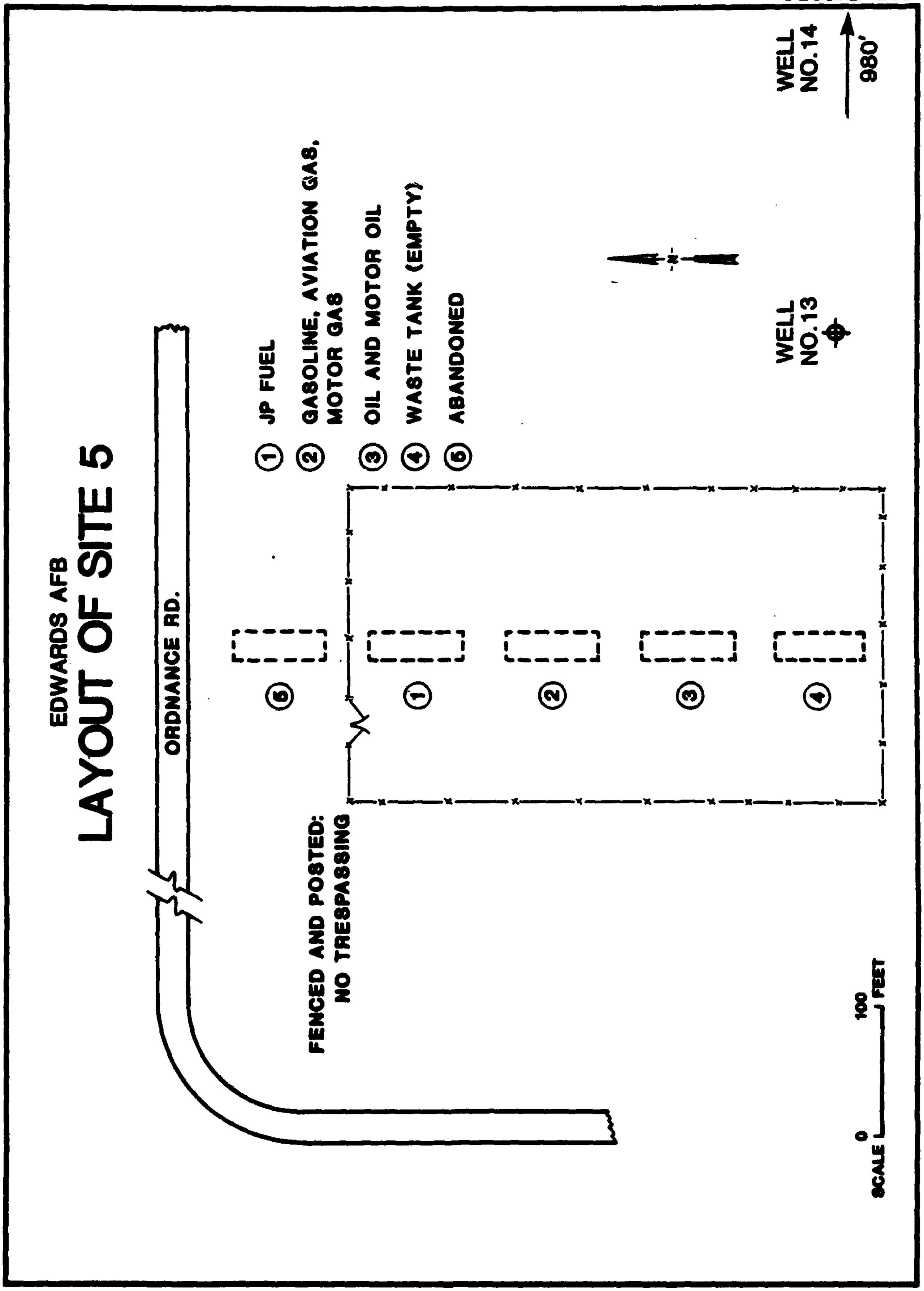
1.3.3.1 Description

This site contains five underground 50,000-gallon capacity steel tanks, each encased in concrete (see Figure 1.5). These tanks were installed in 1942. The tanks are presently used to store waste fuels and oils contaminated with water. A sign near Tank 4 indicates that it contained petroleum oil. In the Phase I IRP report, this tank is reported to have leaked, but the quantity lost is unknown. This tank has been emptied and is no longer used. Topography in this area is flat with sandy soils and very little sign of surface drainage. Even though the site is remote from most of the Main Base activities, it is completely fenced and the gate is kept locked. The site covers approximately one acre.

1.3.3.2 Nature and Extent of Contamination

Two aquifers have been found under Site 5: a shallow aquifer at about a 50-foot depth flowing in an easterly direction, and a deep aquifer starting at a depth of about 100 feet flowing in a southerly direction. A total of six wells have been installed at this site, one up gradient and three down gradient in the deep aquifer and two down

FIGURE 1.5



EDWARDS AFB
LAYOUT OF SITE 5
ORDNANCE RD.
① JP FUEL
② GASOLINE, AVIATION GAS, MOTOR GAS
③ OIL AND MOTOR OIL
④ WASTE TANK (EMPTY)
⑤ ABANDONED
FENCED AND POSTED: NO TRESPASSING
WELL NO.13
WELL NO.14
980'
SCALE 0 100 FEET

gradient in the shallow aquifer. Nonhalogenated volatile organics were detected adjacent to the site at a level of 4,000 mg/kg in the soil at a depth of 45 feet (Well No. 13). This concentration decreased to 300 mg/kg 400 feet down gradient at the same depth (Well No. 14). No contamination was found in water sampled from either Well No. 13 or Well No. 14. Contamination of the shallow aquifer was discovered in an existing water well (i.e., Well No. 6N) about one-half mile north of Site 5. The shallow aquifer gradient at Site 5 is to the east. Phase II (i.e., Stage 3) investigations are being continued to identify the source of this contamination. Based on the ground water gradient information collected to date, this contamination does not appear to originate at Site 5.

1.3.3.3 Location of Receptors

Site 5 is remote from base activities. The nearest production well is 4,000 feet away down gradient. To date, no ground-water contamination has been detected at this well due to Site 5 activities.

1.3.4 Other Sites

1.3.4.1 Site 3 - Abandoned Sanitary Landfill

Site 3 is a closed Class II-2 landfill (see Figure 1.6). The landfill was the active Main Base sanitary landfill from the mid 1960s until 1976 when the present Main Base landfill was opened.

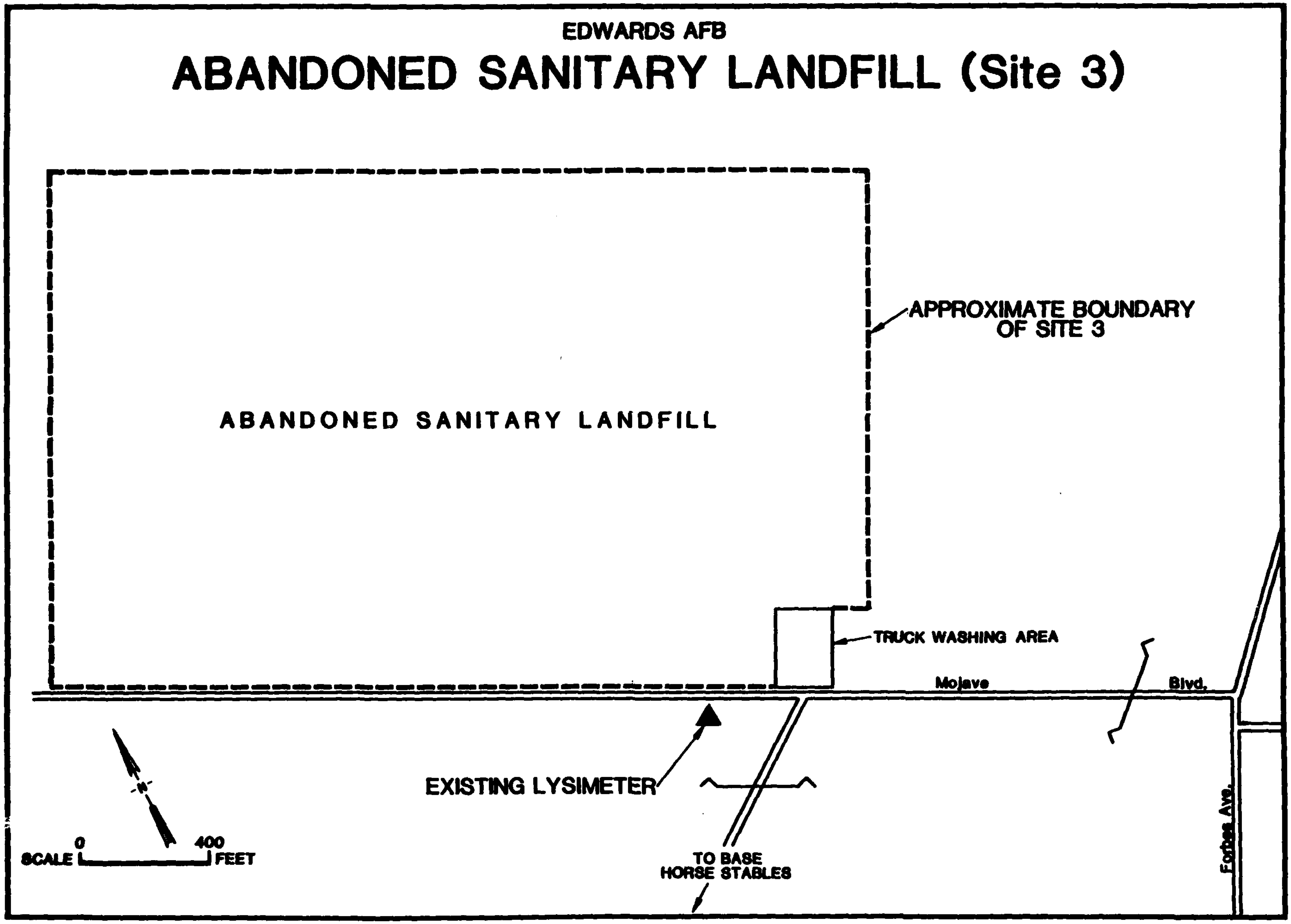
1.3.4.2 Site 4 - Main Base Sanitary Landfill

Site 4 is the active Main Base Class II-2 sanitary landfill (see Figure 1.7). The landfill was opened in 1976. The site is a cut-and-fill type operation which consists of refuse disposal trenches, a construction waste pit, and a waste pit used to dispose of hospital wastes such as bandages, syringes, etc.

1.3.4.3 Site 8 - Industrial Waste Pond

Site 8 (Figure 1.8) is the storm water containment pond which collects storm waters diverted into the storm water system from along the flight line. The pond also receives small quantities of liquid wastes from several aircraft hanger floor drains.

FIGURE 1.6



ENGINEERING-SCIENCE

FIGURE 1.7

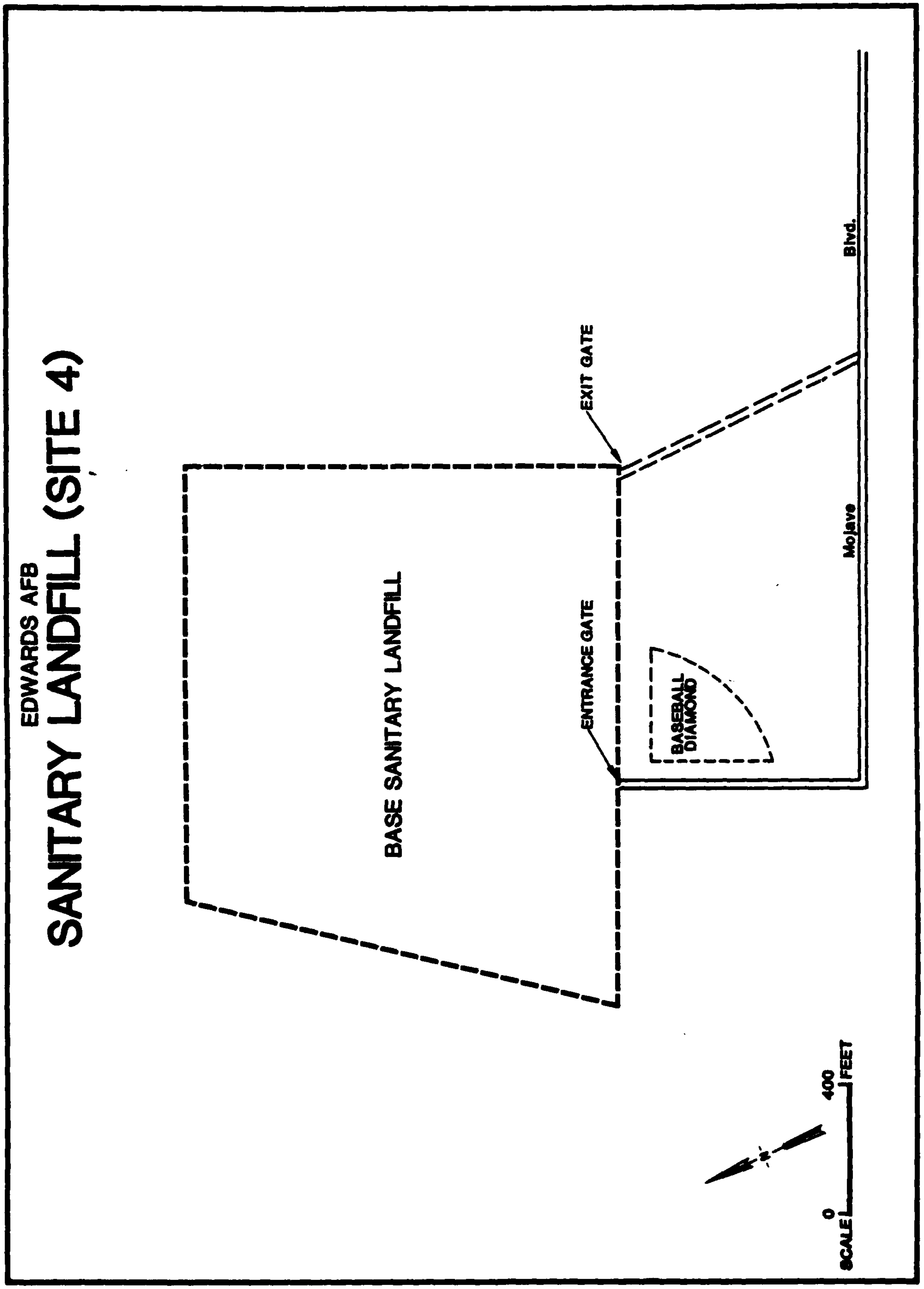
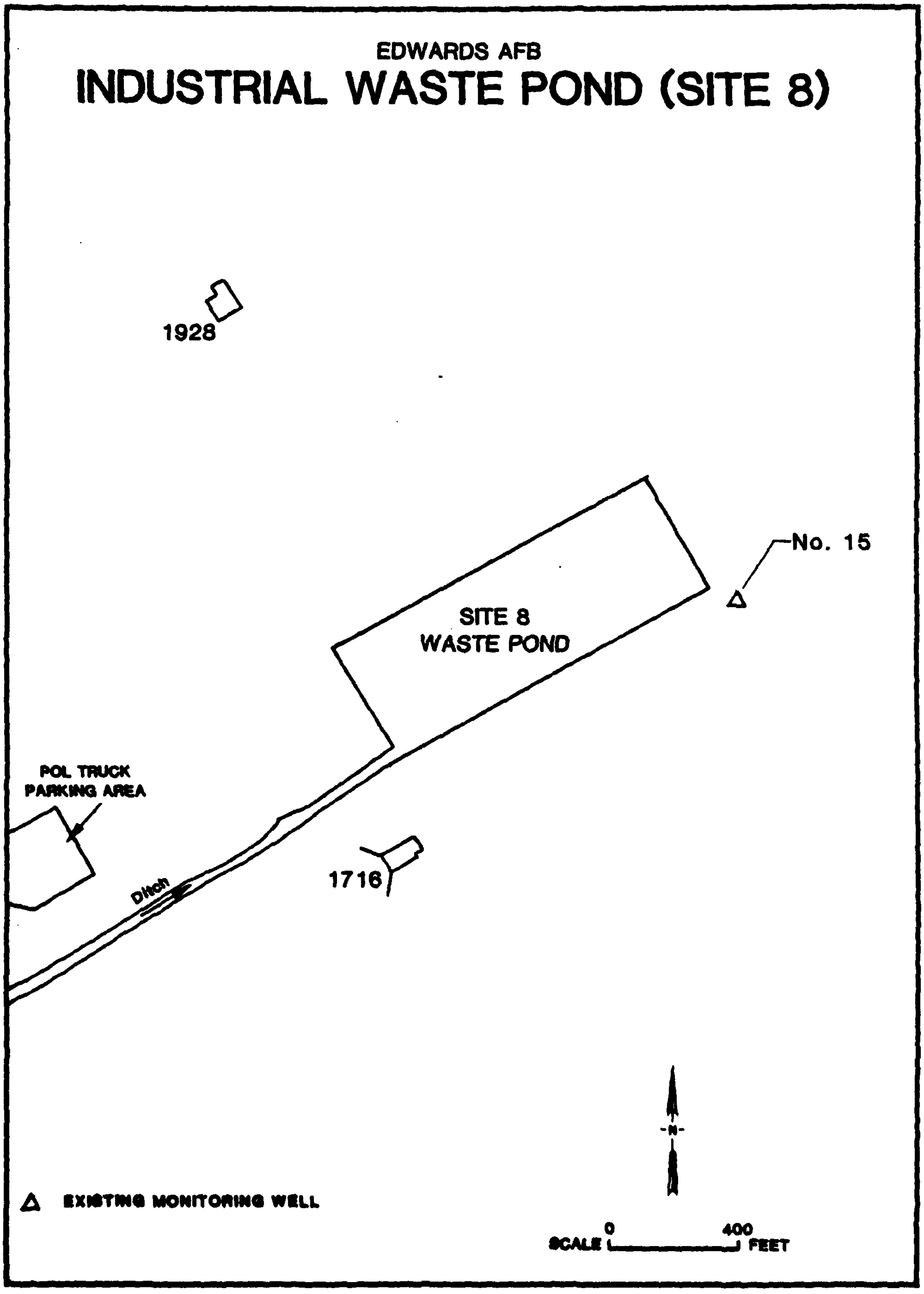

EDWARDS AFB
SANITARY LANDFILL (SITE 4)
BASE SANITARY LANDFILL
EXIT GATE
ENTRANCE GATE
BASEBALL DIAMOND
Mojave
Blvd.
N
SCALE
0
400
FEET

FIGURE 1.8



EDWARDS AFB
INDUSTRIAL WASTE POND (SITE 8)
1928
No. 15
SITE 8
WASTE POND
POL TRUCK
PARKING AREA
Ditch
1716
N
EXISTING MONITORING WELL
0
400
SCALE
FEET

1.3.4.4 Site 13 - Air Force Rocket Propulsion Laboratory Sanitary Landfill

Site 13 is the active Class II-2 sanitary landfill at the Air Force Rocket Propulsion Laboratory for commercial and construction waste (see Figure 1.9).

1.4 OBJECTIVE OF REMEDIAL ACTION

The main objective of Phase IV efforts is to prepare a remedial action plan that, when carried out, will result in the effective cleanup and/or closure of uncontrolled hazardous waste sites. It is anticipated that costs and technological constraints will preclude the removal of all contamination at some sites in favor of effective containment and immobilization.

Selected remedial actions have as top priority the protection of ground and surface waters and, ultimately, of public health.

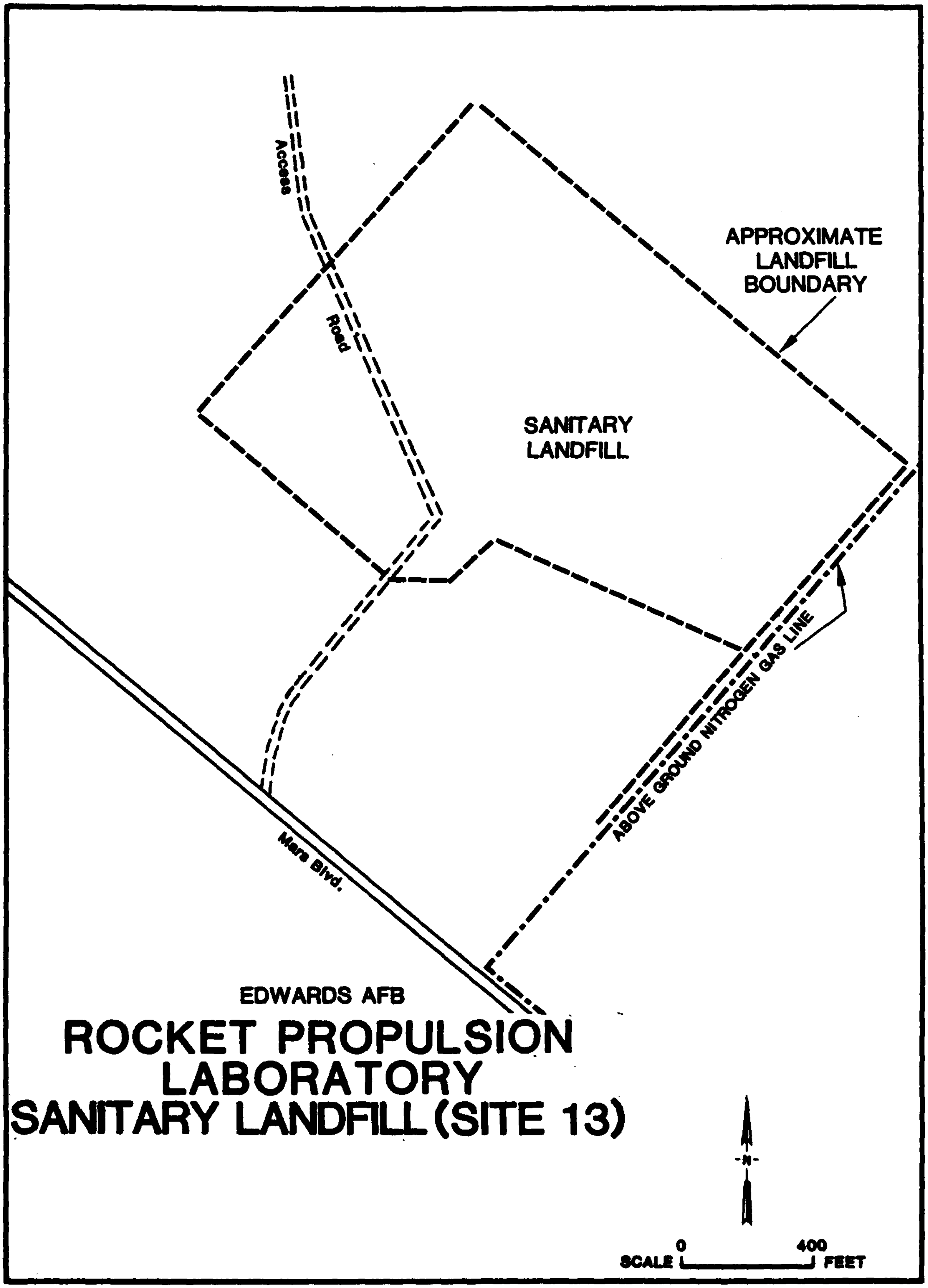
1.5 METHODOLOGY

Figure 1.10 displays the methodology followed by Engineering-Science (ES) in preparing this Phase IV Remedial Action Plan for Sites 1, 2, and 5. As shown, the project was conducted in three steps: identification and preliminary screening of all possible remedial action alternatives, detailed analysis of preferred alternatives, and preparation of conceptual documents.

This methodology follows the Installation Restoration Program Phase IV Management Guidance Manual developed by AFESC at Tyndall AFB both in overall approach and in evaluation of alternatives.

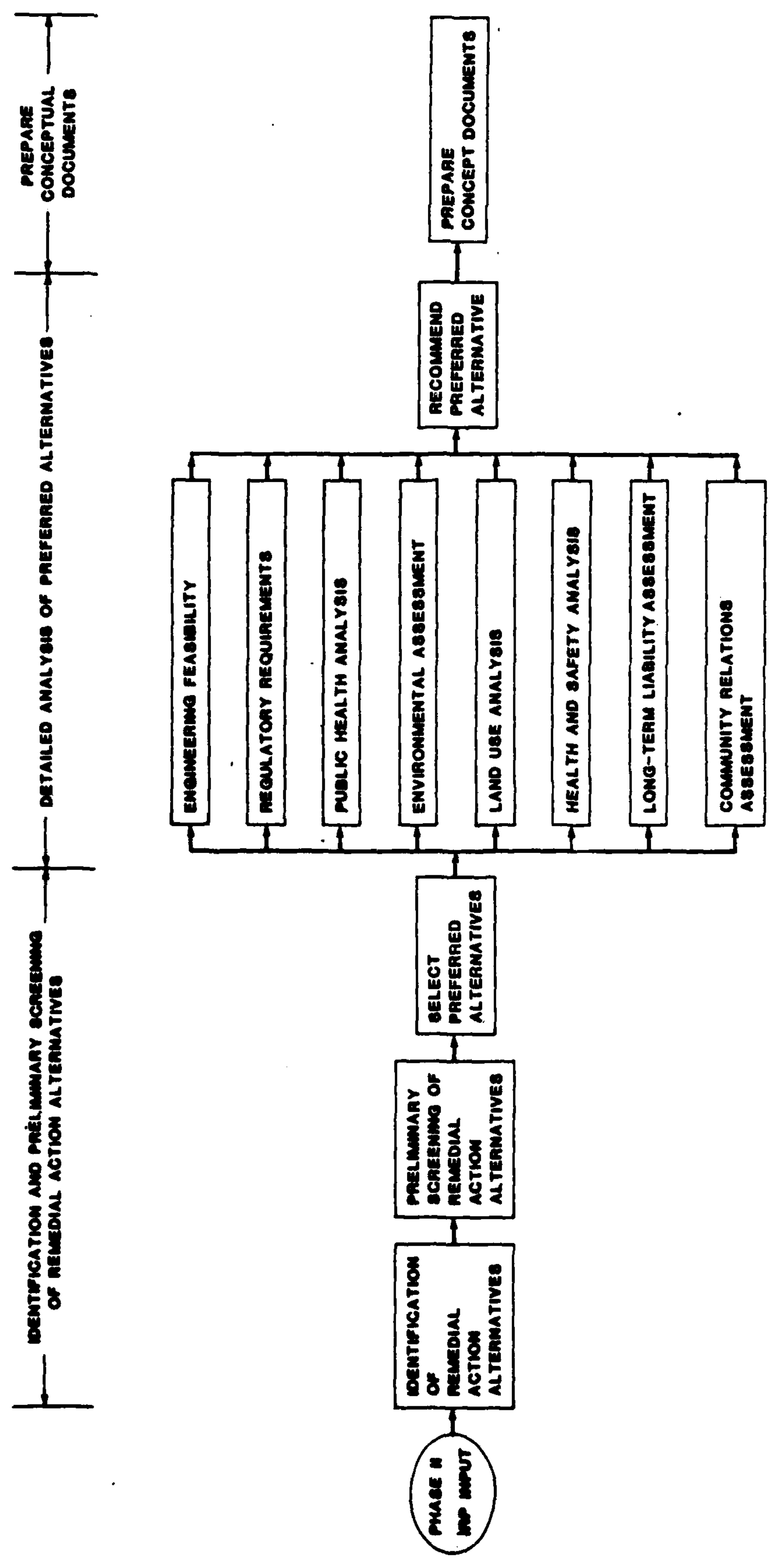
The remedial actions selected for Sites 3, 4, 8, and 13 (i.e., installation/monitoring of lysimeters or wells) were recommended in the Phase II document. These actions were reviewed and concurred by State and County Regulatory Agencies. Because of this concurrence and because the remedial actions chosen had no alternatives, these actions were not analyzed per the AFESC criteria contained in the IRP Phase IV Management Guidance Manual.

FIGURE 1.9



ES ENGINEERING-SCIENCE

FIGURE 1.10



PHASE IV
EDWARDS AFB
REMEDIAL ACTION METHODOLOGY

ENGINEERING-SCIENCE

SECTION 2

IDENTIFICATION AND PRELIMINARY SCREENING OF REMEDIAL ACTION ALTERNATIVES

2.0 INTRODUCTION

This section identifies the remedial action technologies that may be applicable for the three sites (1, 2, and 5) at Edwards AFB. Each of these was subjected to a two-phase screening process. First, remedial actions were eliminated when they failed to meet basic engineering, cost, regulatory, environmental or health risk criteria. This initial screening phase was used to reduce the potential alternatives to a select few. Basic engineering feasibility and cost were the primary criteria although regulatory, environmental impact and health risk criteria were also considered.

The second screening process was based on a more detailed evaluation of each remedial action. Alternatives were scored in a general sense (unfavorable, fair, favorable) in each of five categories: cost, environmental impact, public health risk, regulatory compliance, and technology feasibility. Total score is not necessarily an indication of overall acceptability. For example, alternatives may score very high in all categories but regulatory compliance and be eliminated. Conversely, the monitoring and site maintenance alternative is retained throughout, regardless of its rating, to act as the base line (i.e., lowest) level of effort for comparison.

The existing technologies applicable to Edwards AFB sites were reviewed with AFESC as part of the technology review.

2.1 IDENTIFICATION OF REMEDIAL ACTION ALTERNATIVES (INITIAL SCREENING)

Eighteen remedial actions were identified for possible application at the three sites at Edwards AFB. These alternatives were selected based on the consultant's experience, recommendations included in the Phase II report, and suggestions from the Phase IV guidance manual. Table 2.1 lists these alternatives. Some of the alternatives may overlap or complement one another. These were combined when applicable. Those considered appropriate for more detailed evaluation at a specific site were identified with an "X". The basic reason(s) for eliminating alternatives are provided below.

2.1.1 Alternative 1 - Monitoring/Site Maintenance

This alternative is applicable at all sites, and represents the base line remedial action.

2.1.2 Alternative 2 - Containment

A barrier wall is applicable only at Site 2 where sloping terrain and shallow bedrock at a 20-foot depth would enhance lateral movement of contaminants. Migration which may occur at other sites would be vertically in the soil column, and therefore not affected by a barrier wall. Capping with impermeable clays or synthetic liners is applicable at each site to prevent infiltration of water and possible mobilization of soluble contaminants.

2.1.3 Alternative 3 - Pumping of Ground Water

There is no detectable ground-water contamination resulting from any of the three sites.

2.1.4 Alternative 4 - Collection of Drainage

It only rains four inches per year on the average at Edwards AFB, and the evaporation rate (average) is approximately 114 inches per year. Collection of surface drainage is not a major issue at any of the sites. If a barrier wall was installed at Site 2, collection of subsurface drainage may be required.

2.1.5 Alternative 5 - Diversion (grading)

Grading to divert surface runoff is applicable at all sites.

TABLE 2.1

POTENTIAL REMEDIAL ACTION ALTERNATIVES

Alternatives	Sites 1A	1B	1C	1D	1E	2	5	Key Factors
1. Monitoring/Site Maintenance	X	X	X	X	X	X	X	• Simplest, least costly option
2. Containment								
• Capping	X	X	X	X	X	X	X	
• Barrier Walls						X		• Little potential for horizontal migration except at 2
3. Pumping of Ground Water								• No ground water contamination; ground water depths: 50-135 feet
4. Collection of Drainage						X		• No surface drainage due to low rainfall, high evaporation rate. Possible sub-surface drainage collection at Site 2
5. Diversion (grading)	X	X	X	X	X	X	X	• Low cost method to reduce potential for contaminant migration
6. Complete Removal								
• Drums/Tanks		X		X	X		X	• No drums/tanks at 1A, 1C, 2
• Soils	X	X	X	X	X	X	X	
7. Partial Removal								
• Drums/Tanks		X		X	X		X	• No drums/tanks at 1A, 1C, 2
• Soils	X	X	X	X	X	X	X	
8. On-site Treatment								
• Incineration		X		X			X	• No liquids at 1A, 1C, 1E; costs are very high
• Solidification of Drummed Material		X		X				• Material not suitable for solidification at 1A, 1C, 1E, 2, 5
• Biological, Chemical, Physical Treatment								• Not cost effective to initiate on-site treatment for low volumes of drummed waste
9. Off-site Treatment		X		X			X	• Potential oil and solvent recovery or solvent incineration (1B, 1D, 5)

TABLE 2.1 (continued)

Alternatives	Sites 1A	1B	1C	1D	1E	2	5	Key Factors
10. In Situ Biological Treatment			X				X	• Injection of denitrifying bacteria (1C); chlorinated hydrocarbons and metals not amenable to in situ treatment at other sites
11. Storage								• Not an ultimate solution
12. Off-site Disposal	X	X	X	X	X	X	X	• Candidate for all in concert with other actions
13. Alternate Drinking Water								• No contaminated drinking water
14. Relocate Receptors								• Receptors not endangered
15. Leaching/Extraction/ Treatment	X	X	X	X	X			• Metals, CN and fuels not amenable to leaching (2, 5)
16. Air Sweeping	X	X		X	X		X	• Air sweeping not applicable to nitrates (1C) and inorganics (2)
17. On-site Disposal (new on-base site)	X	X	X	X	X	X	X	• Candidate for all sites in concert with other actions; time constraints and costs are disadvantages
18. Disposal of Empty Tanks and Drums in Place		X		X	X		X	• No tanks/drums at 1A, 1C and 2

<u>Key</u>
X = Considered a candidate for further evaluation.

2.1.6 Alternative 6 - Complete Removal

There are no drums or tanks to be removed at Subsites 1A, 1C, and Site 2. Complete removal of contaminated soils, although very costly, is applicable at all sites.

2.1.7 Alternative 7 - Partial Removal

There are no drums or tanks to be removed at Subsites 1A, 1C, and Site 2. Removal of surface contaminated soils is applicable at all sites.

2.1.8 Alternative 8 - On-Site Treatment

Costs are very high for on-site incineration, particularly since the volumes of liquids are so low, and the concentrations of substances in the soils are generally low. However, incineration of contaminated soils at Subsites 1B and 1D, and Site 5 is conceivable. Solidification of drummed material is appropriate only at Subsite 1B and possibly at Subsite 1D. Other sites do not have drums, and Site 5 material will be salvaged, not solidified. Biological, chemical, and physical treatment are not appropriate for the drummed chemicals at the sites due to the very small quantities of waste.

2.1.9 Alternative 9 - Off-Site Treatment

Only the drummed wastes at Subsites 1B and 1D and the waste POL at Site 5 are applicable for off-site treatment.

2.1.10 Alternative 10 - In Situ Treatment

The nitrates at Subsite 1C and the fuels and oils at Site 5 are amenable to in situ biological treatment. Technologies for in situ treatment of heavy metals have not been demonstrated.

2.1.11 Alternative 11 - Storage

Storage is not an acceptable permanent solution for Phase IV remedial actions at any of these sites.

2.1.12 Alternative 12 - Off-Site Disposal

This alternative is applicable for all sites and will be combined with other alternatives as appropriate.

2.1.13 Alternative 13 - Alternative Drinking Water

Drinking water supplies are not threatened by contaminants from any of the Edwards AFB sites.

2.1.14 Alternative 14 - Relocate Receptors

Receptors are not endangered because the sites are remote from populations and producing water wells.

2.1.15 Alternative 15 - Leaching/Extraction/Treatment

Only the volatile organics and nitrates are amenable to leaching. Metals, cyanide and fuels are not effectively stripped from the soil by flushing with water.

2.1.16 Alternative 16 - Air Sweeping

Air sweeping may be applicable for volatile organics and gases in the soil. It will not work effectively for inorganics (Site 2) and nitrates (Subsite 1C).

2.1.17 Alternative 17 - On-Site Disposal (new site on base)

It is feasible for wastes from all the sites to be hauled to a new Class I site developed on the base.

2.1.18 Alternative 18 - Disposal of Empty Tanks and Drums in Place

This alternative is applicable for the sites that have drums or tanks.

2.2 PRELIMINARY SCREENING CRITERIA

Five main criteria were used to screen the initial list of alternative remedial actions: technical applicability, environmental impact, public health risk, regulatory compliance/acceptability, and cost. The basic elements of each of these criteria are discussed below.

2.2.1 Technical Applicability

The technical applicability of a remedial action technology refers to its ability to achieve performance standards such as: (a) protection of the ground-water aquifer, and (b) minimization of emissions. In addition, the ease of implementation is important. Many alternatives

will not be suitable for the Edwards AFB sites. For example, extraction and treatment of ground water at Site 2 is not appropriate since there is no affected ground water.

This criteria provides an effective means of reducing a very large number of alternatives to those that are applicable from an engineering standpoint.

2.2.2 Environmental Impact

The most important environmental impact at all three Edwards' sites is the potential for ground-water contamination. Each alternative was screened in consideration of its ability to prevent contamination of fresh water aquifers.

2.2.3 Public Health Risk

The key concern of the Air Force regarding the IRP program, and particularly Phase IV, is protection of public health. Potential areas of risk are: contamination of ground-water supplies, emissions of volatile organic compounds to the atmosphere, spills of hazardous substances during transportation to acceptable disposal sites, exposure of the public or workers to toxic substances during cleanup operations, accidental or purposeful entry into the sites and subsequent contact with hazardous wastes by unauthorized personnel.

2.2.4 Regulatory Compliance/Acceptability

The involved regulatory agencies for the Edwards AFB project and their areas of responsibility are as follows:

- Lahontan Regional Water Quality Control Board (Victorville)
  Responsibility: impacts on ground water and surface water

- Kern County Health Department (Bakersfield)
  Responsibility: public health aspects of remedial actions

- State Department of Health Services (Fresno Region)
  Responsibility: review and approval of remedial actions including proper closure alternatives and control of toxic air emissions

- U. S. Environmental Protection Agency Region IX (San Francisco)
  Responsibility: oversight of DHS review and remedial actions

- Kern County Air Pollution Control District (Bakersfield)
  Responsibility: review of remedial actions regarding potential emissions of volatile organics during cleanup and transportation

Preferred alternatives must have regulatory agency support. Discussions were conducted by the USAF with the above agencies to define their preferences early in the project, before final decisions were made, and to assure that the preferred remedial approaches being considered were acceptable (refer to Appendix L).

2.2.5 Cost

Cost is an important factor in the ranking of remedial actions. Important contributors to cost include: purchase of equipment and materials, construction, and long-term operation and maintenance. O&M costs are particularly important as the Air Force Flight Test Center has required that sites be monitored and cleanup facilities operated for 50 years. Therefore, the thrust of the cost analysis was to favor alternatives that minimized long-term O&M costs even if a higher initial capital cost was involved.

2.3 PRELIMINARY SCREENING OF REMEDIAL ACTION ALTERNATIVES (SECONDARY SCREENING)

Preliminary screening of the alternatives remaining from the above selection are presented in this section. This second round of evaluation identifies the preferred five or six alternative remedial actions for each site. The preferred alternatives are then evaluated in detail in Section 3 and the selected alternative for each site highlighted in Section 4.

Tables 2.2 through 2.6 summarize the evaluation of the potential remedial action alternatives that were not eliminated from the initial screening process. Alternatives for each site were scored according to a set of screening criteria and a decision was made as to whether or not to retain the alternative as "preferred" and then to consider it in the

TABLE 2.2

EVALUATION OF POTENTIAL REMEDIAL ACTION ALTERNATIVES

SUBSITE 1A

Alternative	Cost	Environ. Impact	Public Health Risk	Regs. Com-pliance	Tech-nology	Engineering Judgment: Comments	Engineering Judgment: Retain Option
1. Monitoring/Site Maintenance	3	3	3	2	3	• Questionable regulatory approval • Potential for contaminant migration • Lowest cost option	Yes
2. Containment (capping)	3	3	3	3	3	• Good alternative • Contaminants still in place	Yes
3. Diversion (grading for site drainage)	3	3	3	3	3	• Must prepare final grades to drain water off site	Yes
4. Complete Removal of Contaminated Soils	1	3	3	3	3	• Best solution from risk and regulations standpoint • Very high cost • Level of hazard does not warrant level of cleanup	No
5. Partial Removal (just contaminated topsoil)	3	3	3	2	3	• Good overall solution • Cost-effective contaminant removal	Yes
6. Off-site Disposal at Class I Site	2	3	3	3	3	• Possible high cost • Good regulatory aspects • Contractor disposal liability	Yes
7. Leaching/Extraction/ Treatment	2	2	3	2	2	• Possible high cost • Low level contamination • Deep ground water (100 feet) • Technology for in situ leaching and treatment of organics will have to be tested prior to full-scale implementation	No
8. Air Sweeping	2	3	3	1	1	• Not proven technology • Uncertain regulatory aspects • Incomplete removal of volatile organics adsorbed on soil	No
9. Disposal at New On-base Landfill	1	3	3	1	3	• Expensive site development • Severe regulatory constraints • Long lead time for permits	No

LEGEND: 1 = Unfavorable (i.e., high cost, severe environmental impacts, high health risk, poor regulatory compliance, unproven or difficult technology
2 = Fair
3 = Favorable

TABLE 2.3

EVALUATION OF POTENTIAL REMEDIAL ACTION ALTERNATIVES

SUBSITES 1B, 1D, 1E

Alternative	Cost	Environ. Impact	Public Health Risk	Regs. Compliance	Technology	Engineering Judgment: Comments	Engineering Judgment: Retain Option
1. Monitoring/Site Maintenance	3	2	2	1	3	• Questionable regulatory approval • Potential for contaminant migration • Lowest cost option	Yes
2. Containment (capping)	3	3	3	2	3	• Good alternative • Contaminants still in place	Yes
3. Diversion (grading for site drainage)	3	3	3	3	3	• Must prepare final grade to drain waste off site	Yes
4. Complete Removal							
• Drums	3	3	3	3	3	• Complete removal of contaminant source • Cost not prohibitive • Good regulatory compliance	Yes
• Contaminated Soils	1	3	3	3	3	• Very high cost • Level of hazard does not warrant level of clean-up	No
5. Partial Removal							
• Drums with Liquid	3	3	3	1	3	• Regulatory agencies want all drums removed	No
• Contaminated Topsoil	3	3	3	2	3	• Cost-effective contamination removal	Yes
6. On-site Incineration	1	3	3	2	3	• Very high cost • Regulatory requirements are complex • Levels of contamination in soil are low	No
7. On-site Treatment[a]							
• Incineration of Solvents and Oils	1	2	3	1	3	• High cost; complex regulatory constraints	No
• Solidification of Drummed Liquids Prior to On-Site Disposal	2	2	3	1	2	• Potential regulatory constraints; extensive solidification testing due to diversity of wastes	No
8. Off-site Treatment[a] (incineration, recycling)	3	2	3	2	3	• Potential for solvent incineration (Lebec, CA) or recovery (Los Angeles, CA) • Potential for waste oil recovery (Los Angeles, Bakersfield, CA)	Yes

TABLE 2.3 (continued)

SUBSITES 1B, 1D, 1E

Alternative	Cost	Environ. Impact	Public Health Risk	Regul. Compliance	Technology	Engineering Judgment: Comments	Engineering Judgment: Retain Option
9. Off-site Disposal at Class I Site	2	3	3	3	3	• Possible high cost • Good regulatory aspects • Contractor disposal liability	Yes
10. Leaching/Extraction/ Treatment	2	3	3	2	2	• High cost • Shallow contamination • Deep ground water (100 feet) • Technology requires considerable testing • Uncertain regulatory aspects	Yes
11. Air Sweeping	2	3	3	1	1	• Not proven technology • Uncertain regulatory aspects • Low level contamination	No
12. Disposal at New On-base Landfill	1	3	3	1	3	• Expensive site development • Severe regulatory constraints • Long lead time for permits	No
13. Disposal of Empty Drums In-place	3	3	3	1	3	• Not favored by regulatory agencies • Simple, inexpensive option	Yes

NOTE: (a) Sites 1B and 1D only; 1E has no liquid

LEGEND: 1 = Unfavorable (i.e., high cost, severe environmental impacts, high health risk, poor regulatory compliance, unproven or difficult technology
2 = Fair
3 = Favorable

TABLE 2.4

EVALUATION OF POTENTIAL REMEDIAL ACTION ALTERNATIVES

SUBSITE 1C

Alternative	Cost	Environ. Impact	Public Health Risk	Regs. Compliance	Technology	Engineering Judgment: Comments	Engineering Judgment: Retain Option
1. Monitoring/Site Maintenance	3	2	2	1	3	• Questionable regulatory approval • Potential for contaminant migration • Lowest cost option	Yes
2. Containment (capping)	3	3	3	3	3	• Immobilizes nitrates in soil • Contaminants still in place	Yes
3. Diversion (grading for site drainage)	3	3	3	3	3	• Must prepare final grades to drain water off site	Yes
4. Complete Removal of Soils to Background Levels	1	3	3	3	3	• Best solution from risk and regulations standpoint • Cost is very high • Receptors not at risk	Yes
5. Partial Removal (just contaminated topsoil)	3	3	2	2	3	• Good overall solution • Cost effective contaminant removal	Yes
6. In Situ Treatment - Denitrifying Bacteria	2	3	3	1	1	• Regulatory aspects uncertain • Not proven technology	No
7. Off-site Disposal at Class I Site	2	3	3	3	3	• Possible high cost • Good regulatory aspects • Contractor disposal liability	Yes
8. Leaching/Extraction/ Treatment	2	3	3	2	2	• Deep contamination - possibly to ground water at 135 feet • Very soluble contaminants • High cost • Not proven technology - requires verification of denitrification process design	Yes
9. Disposal at New On-base Landfill	1	3	3	1	3	• Expensive site development • Severe regulatory constraints • Long lead time for permits	No

LEGEND: 1 = Unfavorable (i.e., high cost, severe environmental impacts, high health risk, poor regulatory compliance, unproven or difficult technology
2 = Fair
3 = Favorable

TABLE 2.5

EVALUATION OF POTENTIAL REMEDIAL ACTION ALTERNATIVES

SITE 2

Alternative	Cost	Environ. Impact	Public Health Risk	Regs. Compliance	Technology	Engineering Judgment: Comments	Engineering Judgment: Retain Option
1. Monitoring/Site Maintenance	3	3	3	2	3	• Lowest cost option • Questionable regulatory approval	Yes
2. Containment							
• Capping	3	3	3	3	3	• Good alternative • Contaminants still in place	Yes
• Barrier Wall (down gradient)	2	3	3	3	3	• High cost • Required only if lateral movement of seasonal water is possible • Shallow bedrock (20 feet) is favorable	Yes
3. Diversion (grading for site drainage)	3	3	3	3	3	• Must prepare final grade to drain water off site	Yes
4. Complete Removal of Contaminated Soils	1	3	3	3	3	• Extent of contamination may not be great; good potential alternative	Yes
5. Partial Removal -- Only Contaminated Topsoil	2	3	3	2	3	• Cost-effective contaminant removal	Yes
6. Off-site Disposal at Class I Site	2	3	3	3	3	• Possible high cost • Good regulatory aspects	Yes
7. Disposal at New On-base Landfill	1	3	3	1	3	• Expensive site development • Severe regulatory constraints • Long lead time for permits	No

LEGEND: 1 = Unfavorable (i.e., high cost, severe environmental impacts, high health risk, poor regulatory compliance, unproven or difficult technology
2 = Fair
3 = Favorable

TABLE 2.6

EVALUATION OF POTENTIAL REMEDIAL ACTION ALTERNATIVES

SITE 5

Alternative	Cost	Environ. Impact	Public Health Risk	Regs. Compliance	Technology	Engineering Judgment: Comments	Engineering Judgment: Retain Option
1. Monitoring/Site Maintenance	3	3	3	2	3	• Questionable regulatory approval • Potential for contaminant migration • Lowest cost option	Yes
2. Containment (capping)	3	3	3	2	3	• Good alternative -- low cost, high benefit • Contaminants still in place	Yes
3. Diversion (grading for site drainage	3	3	3	3	3	• Must prepare final grades to drain water off-site	Yes
4. Complete Removal of Tanks and All Contaminated Soils	1	3	3	3	3	• Complete removal of source of contamination • Prohibitive cost • Level of hazard does not warrant level of cleanup (no groundwater contamination)	No
5. Removal of Tanks and Contaminated Soil Around Tanks	2	3	3	3	3	• Cost-effective contaminant removal	Yes
6. On-site Incineration	1	3	3	2	3	• Costs are very high • Regulatory requirements are complex • Levels of contamination in soils are low	No
7. Off-site Treatment - Incineration/Recovery of Waste Oils and Fuels	3	3	3	2	2	• Quality of waste oils and fuels may be too poor for recovery • May be difficult to locate incineration facilities that will take wastes	Yes
8. In Situ Biological Treatment	2	2	3	2	1	• Unproven technology • Has good potential	No
9. Off-site Disposal	2	3	3	3	3	• High cost if tanks excavated and hauled	Yes
10. Air Sweeping	2	3	3	2	1	• Unproven technology with good potential for cases of gaseous contamination	No

TABLE 2.6 (continued)

SITE 5

Alternative	Cost	Environ. Impact	Public Health Risk	Regs. Compliance	Technology	Engineering Judgment: Comments	Engineering Judgment: Retain Option
11. Disposal at New On-base Landfill	1	3	3	1	3	• Very expensive - requires double liner system • Severe regulatory constraints • Extensive monitoring • *Long lead time for permits*	No
12. Disposal of Empty Tanks In-place	3	3	3	2	3	• Relatively low cost (empty tanks, rip open, fill with clean sand) • Potential regulatory contraints • Minimal risks and impacts	Yes

LEGEND: 1 = Unfavorable (i.e., high cost, severe environmental impacts, high health risk, poor regulatory compliance, unproven or difficult technology
2 = Fair
3 = Favorable

last evaluation. As previously mentioned, the scoring system is subjective, and a high total score does not necessarily mean an alternative is preferred. For example, an "unfavorable" indication in regulatory compliance would cause the elimination of an otherwise high scoring alternative. The monitoring/site maintenance alternative will be retained regardless of rating to function as the base line alternative.

The discussion below summarizes the reasons for eliminating alternatives at this step.

2.3.1 Subsite 1A

2.3.1.1 Complete Removal of Contaminated Soils

This alternative was eliminated due to very high cost (greater than $1 million), and the fact that the low levels of contamination do not warrant this extensive remedial action. Contaminant levels were: chloroform (0.35 to 0.69 mg/kg), Freon 11 (1.65 to 14.8 mg/kg), and fuel oil smell to a 15-foot depth.

2.3.1.2 Leaching/Extraction/Treatment

This alternative was eliminated due to the unproven nature of this technology and the low levels of contamination in the soil. The high potential cost of system operation and maintenance over an unknown period of time is also a negative feature.

2.3.1.3 Air Sweeping

Although a promising technology for removal of gases and volatile materials in soil, it is not proven and, as such, is inappropriate for Phase IV application that stresses the use of proven, available technologies. This remedial action may be appropriate for Phase III R&D by AFESC, Tyndall AFB.

2.3.1.4 Disposal at New On-Base Landfill

This alternative was eliminated primarily due to severe regulatory constraints. Even if a Class I (California) site were approved, it would take at least three years to get the treatment, storage, disposal (TSD) permits and construct the site. For the low volume of waste at Edwards AFB, it is not a practical option.

2.3.2 Subsites 1B, 1D, and 1E

2.3.2.1 Complete Removal of Soils

The cost of this option is very high and unwarranted for the low levels of contaminants in the soil at these sites.

2.3.2.2 Removal of Drums with Liquid (i.e., Partial Removal)

This alternative is applicable for Subsites 1B and 1D and would eliminate any uncertainties as to future contamination from wastes which may be left in the drums. The Lahontan RWQCB strongly advised that Edwards AFB remove all drums (full or empty) from the sites and not leave anything buried on site.

2.3.2.3 On-Site Incineration

This alternative was eliminated because of high costs, complex regulatory requirements and the low levels of contamination in the soil.

2.3.2.4 On-Site Treatment

Incineration on site is an expensive option with many regulatory ramifications. If a large volume of liquid waste was involved, this option might be more attractive. For the few drums containing liquid at Edwards AFB, incineration is not cost-effective. Likewise, solidification is not feasible for these low volumes and the diverse nature of drummed wastes. If solidification of drummed waste is required, it would seem advantageous to have this carried out at the Class I disposal site. Contaminated soil incineration is also not cost-effective due to the low levels of contamination and the high cost of the combustion system.

2.3.2.5 Air Sweeping

Although promising for future R&D work, air sweeping is not a proven technology and would require extensive monitoring to assure regulatory personnel of its performance.

2.3.2.6 Disposal at New On-Base Landfill

For the relatively low volumes of waste at Edwards AFB, it would be expensive and difficult from a regulatory standpoint to develop a hazardous waste disposal site on base. If large waste volumes and

millions of dollars in disposal fees were involved, this alternative would have greater potential.

2.3.3 Subsite 1C

2.3.3.1 In Situ Treatment - Denitrifying Bacteria

This option was eliminated because the injection of denitrifying bacteria to convert nitrates to nitrogen gas is not a proven technology.

2.3.3.2 Disposal at New On-Base Landfill

Since these soils are contaminated only with nitrates, it should be possible to dispose of them at the base sanitary landfill or spread the soil out in an area with no useable ground water so that the nitrate concentration is similar to that of commercial fertilizer. A new hazardous waste landfill is not required.

2.3.4 Site 2

Disposal at New On-Base Landfill

This alternative was eliminated primarily due to severe regulatory constraints. Even if a Class I (California) site were approved, it would take at least three years to get the TSD permits and construct the site. For the low volume and concentrations of wastes at Site 2, this is not a practical option.

2.3.5 Site 5

2.3.5.1 Complete Removal of Tanks and All Contaminated Soils

Soils contaminated with oil were encountered at a 45-foot depth in two wells installed in the shallow aquifer east of the site. It would cost hundreds of thousands and perhaps millions of dollars to remove these soils. There is no indicated contamination of the ground water at this site due to Site 5 activities, and the low level of hazard does not warrant this extensive cleanup.

2.3.5.2 On-Site Incineration

This alternative was eliminated because the waste POL should be salvaged not burned, the costs of incinerating contaminated soil are very high, and regulatory requirements are complex.

2.3.5.3 In Situ Biological Treatment

This alternative was eliminated because the technology, although promising, is not proven. Costs and performance are unknown, regulatory aspects uncertain.

2.3.5.4 Air Sweeping

Although promising for future R&D work, air sweeping is not a proven technology and would require extensive monitoring to assure regulatory personnel of its performance.

2.3.5.5 Disposal at New On-Base Landfill

This alternative was eliminated primarily due to severe regulatory constraints. Even if a Class I (California) site were approved, it would take at least three years to get the TSD permits and construct the site. For the low volume of waste at Edwards, it is not a practical option.

SECTION 3

DETAILED ANALYSIS OF PREFERRED REMEDIAL ACTION ALTERNATIVES

3.0 INTRODUCTION

A preliminary screening of remedial action alternatives for Sites 1, 2 and 5 at Edwards AFB was presented in Section 2. The preferred alternatives will be refined and fully developed for each site herein so that the most practical alternative which meets the cleanup objectives of the IRP, can be selected. The detailed analysis of preferred remedial alternatives includes a review of engineering feasibility, regulatory and permit requirements, public health analysis, environmental assessment, land use restrictions, health and safety requirements, long-term liability, community relations, cost analysis and environmental monitoring requirements.

3.1 SITE 1 - NORTH LAKE BED DISPOSAL AND STORAGE SITE

3.1.1 Alternative Descriptions

The four preferred alternatives for Subsites 1A, 1B, 1C, 1D and 1E at North Base are briefly described in Table 3.1. Each alternative for Subsites 1A and 1E collectively includes the installation of four 200-foot deep ground-water monitoring wells (one up gradient and three down gradient) during closure activities. These wells are to be installed to a 200-foot depth due to projected utilization of ground water in the Antelope Valley over the next 50 years in the vicinity of Site 1. Based on field measurements taken during early July 1984, the pumping levels of Well Nos. 3 and 5 near Site 1 are 150 feet below ground surface. At the same time, the static water level of abandoned Well No. 11 was 120 feet below ground surface. Consequently, the top of the screen for each monitoring well should be set at 120 feet. Based on

TABLE 3.1

SITE 1
PREFERRED REMEDIAL ACTION ALTERNATIVES

	Remedial Action	Alternative Discription
1-1	Monitoring/Site Maintenance	• Install 9 post-closure monitoring wells (2 up gradient and 7 down gradient) • Install security fence around Subsites 1C and 1D
1-2	Remove All Drums and Immobilize Contaminants	• Remove all surface drums containing waste at Subsites 1A, 1B, 1C, 1D, and 1E and haul to a secure Class I disposal facility. Steam clean empty drums and dispose of in the Main Base sanitary landfill. Collect drum rinsate in an evaporation pond. Haul residue to a secure Class I disposal facility. • Cap Subsites 1C and 1D with synthetic liner and local playa clay deposits
1-3a	Remove All Drums and Totally Excavate Soil at Subsites 1C and 1D (contract disposal)	• Remove all surface drums containing waste at Subsites 1A, 1B, 1C, 1D, and 1E and haul to a secure Class I disposal facility. Steam clean empty drums and dispose of in the Main Base sanitary landfill. Collect drum rinsate in an evaporation pond. Haul residue to a secure Class I disposal facility. • Excavate NO_3 contaminated soil at Subsite 1C and soil at Subsite 1D to 100-foot depth and haul to secure Class I disposal facility
1-3b	Remove All Drums and Totally Excavate Soil at Subsites 1C and 1D (on-site disposal for Subsite 1C soils)	• Remove all surface drums containing waste at Subsites 1A, 1B, 1C, 1D, and 1E and haul to a secure Class I disposal facility. Steam clean empty drums and dispose of in the Main Base sanitary landfill. Collect drum rinsate in an evaporation pond. Haul residue to a secure Class I disposal facility. • Excavate NO_3 contaminated soil at Subsite 1C to 100-foot depth and haul to on-site disposal • Excavate soil at Subsite 1D to a 100-foot depth and haul to secure Class I disposal facility

TABLE 3.1 (continued)

	Remedial Action	Alternative Discription
1-4	Remove All Drums/ In Situ Leaching of Nitrates and Organics	• Remove all surface drums containing waste at Subsites 1A, 1B, 1C, 1D, and 1E and haul to a secure Class I disposal facility. Steam clean empty drums and dispose of in the Main Base sanitary landfill. Collect drum rinsate in an evaporation pond. Haul residue to a secure Class I disposal facility. • Install well points and percolation pond at Subsites 1B, 1C, and 1D • Treat leached water using on-site air stripping, biological denitrification and carbon adsorption treatment system

maximum ground-water drawdown projections in the Antelope Valley (i.e., with little recharge and all existing wells pumping), the water level decrease over the next fifty years may be as much as 78 feet from the static water level (Reference 5, Appendix J). Hence the depth should be set at 200 feet to ensure long-term sampling. The wells should be screened from a depth of 120 feet to 200 feet below ground surface since (a) a permeable sand and gravel zone exists throughout this depth based on Well No. 9 log, and (b) suspected contaminants at Site 1 may be classified as "floaters," "sinkers," and those which readily disperse throughout the water medium. Monitoring of the wells is to be performed on a routine basis for TOC, pH, specific conductivity, volatile organic compounds and fuel oils. Likewise, each alternative for Subsites 1B, 1C, and 1D includes one up-gradient and four down-gradient 200-foot deep wells. Monitoring at Subsites 1B, 1C and 1D is to be performed on a routine basis for TOC, pH, specific conductivity, nitrates, volatile organic compounds, and fuel oils.

In addition, each alternative includes a 6-foot high security fence with warning signs to be installed around Subsites 1C and 1D upon completion of the remedial action. The purpose of the fence is to keep people from damaging the cap that will be constructed over the subsites.

3.1.1.1 <u>Alternative 1-1 - Monitoring/Site Maintenance</u>

This alternative involves the installation of the monitoring wells as described above, and a security fence around Subsites 1C and 1D.

3.1.1.2 <u>Alternative 1-2 - Remove Drums and Immobilize Contaminants</u>

Alternative 1-2 consists of removing debris and associated soil, and drums containing waste from the surface at Subsites 1A, 1B, 1D and 1E and hauling the materials to a secure Class I contract hazardous waste disposal site. Empty drums would be steam cleaned and disposed of in the Main Base sanitary landfill. Rinsate generated during the drum cleaning operation would be collected in a polyethylene-lined evaporation pond. Once the rinsate has evaporated, the liner and residue would be hauled to a Class I disposal site. All subsites would be graded to natural contours with local soil.

Subsites 1C and 1D would be covered with a 6-inch layer of native sandlike soil to act as a cushion for a synthetic liner. Each pit would then be covered with a synthetic liner. Subsite 1D is less critical than 1C, but would be capped anyway because of the close clustering of the subsites. The synthetic liner would then be capped with a 2-foot layer of local playa clay deposits from Rogers Dry Lake Bed. The purpose of the playa clay is to protect the synthetic liner from exposure to ultraviolet light and to provide an additional low permeability layer. From an engineering standpoint, clay is not needed for this application; however, it was selected due to its local availability. Surface erosion and ponding would be controlled by mounding the clay cap and installing surface swales to divert rainwater away from the pits and towards Rogers Dry Lake Bed. Following placement of the playa clay, 3 inches of crushed gravel would be placed on the clay cap to prevent wind erosion and to discourage burrowing by wildlife. The heavy equipment used for earth moving would be decontaminated using a steam cleaner before leaving the site. Any contaminated water would then be collected in a portable storage pool and allowed to evaporate. Residues would be hauled to a secure Class I landfill site for disposal. As with each remedial alternative for Site 1, post-closure monitoring wells would be installed to a depth of 200 feet at Subsites 1A, 1B, 1C, 1D, and 1E. Each well would be fitted with a stainless steel slotted screen (Figure 3.1). In addition, a 6-foot security fence would be installed around Subsites 1C and 1D to prevent trespassing.

Ongoing responsibilities for alternative 1-2 will include groundwater sampling and analysis, and periodic inspection and maintenance of the cover, drainage, and security systems.

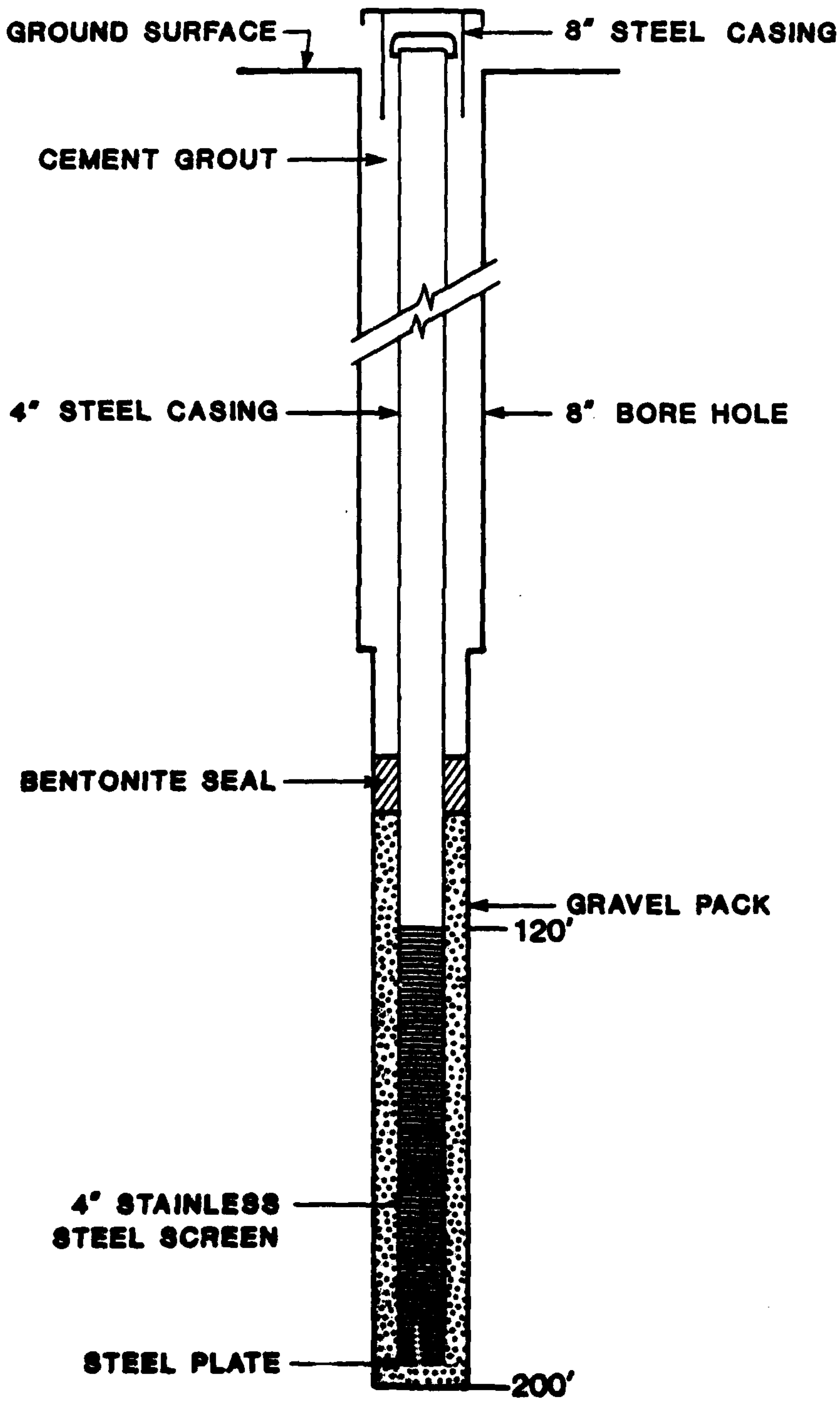
3.1.1.3 Alternative 1-3a - Remove Drums and Totally Excavate Soil at Subsites 1C and 1D (contract disposal)

This alternative consists of removing debris and associated soil, and drums containing waste from Subsites 1A, 1B, 1D, and 1E and hauling the material to a secure Class I contract disposal site. Empty drums would be steam cleaned and be disposed of in the Main Base sanitary landfill. Rinsate generated during the drum cleaning operation would be collected in a polyethylene-lined evaporation pond. Once the rinsate

FIGURE 3.1

EDWARDS AFB

MONITORING WELL DESIGN FOR SITES 1A, 1B, 1C, 1D AND 1E



(NOT TO SCALE)

has evaporated, the liner and residue would be hauled to a Class I disposal site. Contaminated soil at Subsites 1C and 1D would be excavated to a depth of 100 feet and hauled to a secure Class I contract disposal site. The excavated pits would then be filled with local soil and graded to original contours. Subsites 1C and 1D are so close together that to excavate Subsite 1C to 100 feet, Subsite 1D must be excavated as well.

In addition, post-closure maintenance of the security fence and sampling and analysis of the monitoring wells would be accomplished.

3.1.1.4 Alternative 1-3b - Remove Drums and Totally Excavate Soil at Subsites 1C and 1D (on-site disposal for Subsite 1C soils)

This alternative is essentially the same as alternative 1-3a, except Subsite 1C soils are disposed of on site at Edwards AFB in a thin layer to achieve nitrogen values equivalent to a fertilizer. The soil would be disked into the native soil to encourage anaerobic decomposition of nitrate.

3.1.1.5 Alternative 1-4 - Remove Drums/In Situ Leaching of Organics and Nitrates

Alternative 1-4 consists of removing debris and associated soil, and drums containing waste from Subsites 1A, 1B, 1D, and 1E and hauling the material to a secure Class I contract disposal site. Subsites 1A and 1E would then be graded to natural contours. At Subsites 1B, 1C, and 1D, a 3-foot deep percolation pond would be constructed over the entire area to provide a constant hydraulic head to leach nitrates and volatile organics from the soil. Well points would be installed at a depth of 150 feet within and around the site to withdraw ground water contaminated with nitrates and organics. The contaminated water would then be treated with an air stripping unit followed by a fixed film biological denitrification unit and carbon columns. The treated water would then be discharged to the percolation pond. This alternative would require remote utilities and constant operation and maintenance.

3.1.2. Engineering Feasibility

An engineering assessment of the technical applicability, reliability and ease of implementation of the remedial alternatives is presented in the following section for each Site 1 alternative.

3.1.2.1 Alternative 1-1 - Monitoring/Site Maintenance

This alternative is technically feasible; however, its reliability as far as prevention of migration of contamination, particularly from Subsites 1C and 1D, is questionable even though levels of contamination are low. This alternative requires no implementation other than installation of the up-gradient and down-gradient monitoring wells and a security fence.

3.1.2.2 Alternative 1-2 - Remove Drums and Immobilize Contaminants

This alternative incorporates readily available and well-demonstrated technologies. For example, several secure off-site contract disposal sites exist within 250 miles of Edwards AFB (Appendix C). Synthetic liners have been shown to be successful in preventing infiltration of rainwater as long as the liners are placed carefully to prevent tears in the fabric and they are adequately protected from ultraviolet (UV) exposure. The local playa clay, to be used as cover, serves a dual purpose of protecting the liner as well as providing an additional impermeable layer. Even though the playa deposits have low permeability (10^{-7} to 10^{-8} cm/sec), they cannot be used alone due to the probability of crack formation in the arid environment at Edwards AFB. A material, such as gravel, is also needed to protect the playa clay from wind erosion and wildlife burrowing. This alternative can be implemented within a few months and requires relatively low-cost, but long-term O&M requirements.

3.1.3.3 Alternative 1-3(a)(b) - Remove Drums and Totally Excavate Soil at Site 1C

This alternative is entirely feasible since it incorporates demonstrated technologies and can be implemented within a few months. Alternative 1-3 offers minimal long-term O&M requirements.

3.1.3.4 Alternative 1-4 - Remove Drums/In Situ Leaching of Organics and Nitrates

Although the unit processes proposed for this alternative have been demonstrated (i.e., well points, air stripping, denitrification, and carbon adsorption), the leach rates and ultimate leachability of nitrates in the soil column at Subsite 1C and volatiles at Subsite 1D are unknown. Hence, the actual time required to cleanse the soils in situ cannot be accurately estimated based on available data. In order to proceed with design of this in situ leaching scheme, an aquifer pump test would be needed to design the well point system. More importantly, the leach rates in situ at Subsites 1C and 1D would have to be determined. To establish these parameters, a series of soil columns will have to be simulated in the lab. This alternative cannot be implemented in the short term (one year), and may have potentially high O&M requirements over the first few years. The operating life for this alternative cannot be estimated at this time. This alternative was recommended to the AFESC as an R&D project for AFESC under Phase III of the IRP. (Reference 13, Appendix J.)

3.1.3 Regulatory and Permit Requirements

A summary of permits and regulations applicable to the preferred remedial actions is described in Table 3.2. The specific permits required for each Site 1 alternative are described below.

3.1.3.1 Alternative 1-1 - Monitoring/Site Maintenance

No specific permits are required under this alternative although, as with all Site 1 alternatives, the frequency and duration of post-closure monitoring well sampling and analysis must be approved by the Lahontan Regional Water Quality Control Board (RWQCB).

3.1.3.2 Alternative 1-2 - Remove Drums and Immobilize Contaminants

The contract haulers are required to have both EPA and California Department of Health Services (DHS) registration and permits for hazardous waste hauling, as well as a hazardous waste transportation license from the U.S. Department of Transportation (DOT). Haulers must also complete proper RCRA manifest forms. In addition, the contract

TABLE 3.2

SUMMARY OF PERMITS AND REGULATIONS
EDWARDS AFB - PHASE IV IRP

Activity	Regulatory Agency	Permit	Regulations
Hazardous Waste Hauling	EPA DHS	Registration (I.D. No.) Registration (I.D. No.)	Equipment, storage facility, training, personnel, etc. (yearly renewal required)
	DOT	Hazardous Waste Transportation License	CFR 49
	CHP*	Inspection	Motor vehicle regulations, load limits
Contract Hazardous Waste Disposal Sites	DHS (EPA)	TSD Facility Permit (RCRA Permit B)	Waste analysis, security, emergency procedures, monitoring
	RWQCB	Waste Discharge Requirements	Construction, monitoring, siting
Remedial Actions			
1. Water Extraction/Treatment/ Recharge (air stripping)	RWQCB	Waste Discharge Requirements	Water quality levels set by RWQCB
	ARB/Kern APC District	Authority to Construct Permit to Operate	Required emissions controls to achieve limits
	DHS	None	Assist local agencies in establishing acceptable air emissions levels
2. Contaminated Soil Excavation	Kern County APC District	Permit to Operate	Air contaminant emissions limits
	DHS	None	Acceptable levels of contaminants in soils
3. Ground Water Monitoring (post closure)	RWQCB	None	Frequency: Discretionary Duration: Discretionary

*CHP: California Highway Patrol

disposal sites are required to have a RCRA treatment, storage, and disposal (TSD) permit from the California DHS. Finally, any contaminated soil excavation which could potentially emit air contaminants will require a permit to operate from the Kern County Air Pollution Control District and the DHS toxic air emissions group prior to commencing remedial action.

3.1.3.3 Alternative 1-3 - Remove Drums and Totally Excavate Soils at Sites 1C and 1D

The regulatory and permit requirements for this alternative are the same as with alternative 1-2.

3.1.3.4 Alternative 1-4 - Remove Drums/In Situ Leaching of Organics and Nitrates

The regulatory and permit requirements for this alternative are the same as with alternative 1-3 except that a waste discharge permit may be required by the Lahontan RWQCB to establish water quality discharge levels for the water extraction/treatment/recharge part of the alternative.

3.1.4 Public Health Analysis

3.1.4.1 Alternative 1-1 - Site/Monitoring Maintenance

The primary public health risks at Site 1 are ground-water contamination, air contamination, and hazards associated with the scattered surface drums and debris. The primary constituents identified in the soil at Subsites 1A, IB, and 1D are chloroform and trichlorofluoromethane (Freon-11). These contaminants have not been found in the ground water although migration of these volatile solvents in the gaseous phase either by infiltration or molecular diffusion into the ground water is a concern. Fortunately, the potential environmental and health risks associated with the identified levels of soil contamination are not significant (see Table 3.3). If contaminants were to enter the ground water, they would migrate down gradient towards water supply wells 11N/9W-32Q1 (Active North Base Well 3) located approximately 1,400 feet northwest of Subsite 1A. Assuming the permeability of the soil at the ground water table is $1x10^{-4}$ cm/sec it would take 13 years for any contaminants to reach Well 3.

TABLE 3.3

COMPARISON OF SOIL CONTAMINANT CONCENTRATIONS WITH VARIOUS AVAILABLE TOXICITY INDICATORS

Contaminant	Site Concentrations (mg/kg) 1A	1B	1C	1D	1E	96 HR(1) LC_{50} (mg/l)	Toxicity Criteria LD_{50} (mg/kg)	LD_{50} Rat (mg/kg)	TLV (ppm)
TCE	ND	ND	NA	0.06-0.283	NA	45	<5,000	4,920	50
Methylene Chloride	ND	ND	NA	0.06 -0.283	NA	220	<5,000	2,136	100
1,1,2,2 Tetra Chlorethane	ND	0.21	NA	ND	NA	21	<5,000	200	1
1,1 Dichloroethane	ND	ND	NA	0.264-0.47	NA	-	<5,000	725	200
Trichlorofluoromethane	1.65 14.8	13.3-17.5	NA	1.2-22.2	NA	-	<5,000	-	1,000
Dichlorofluoromethane	ND	ND	NA	2.38	NA	-	<5,000	-	1,000
Chloroform	0.35-0.69	0.30-0.37	NA	0.11-0.47	NA	-	<5,000	200	10
NO_3	NA	NA	965-19,400	NA	NA	-	-	-	-
pH (units)	NA	NA	0.4-6.8	NA	NA	-	-	-	-

(1) Bluegill

Definitions:

- LC_{50} - Concentration that is lethal to 50 percent of the test population.
- LD_{50} - Dosage that is lethal to 50 percent of the test population.
- TLV - Threshold limit value representing acceptable exposure limit.
- ND - Not detected
- NA - Not applicable
- \- - Not available

Due to the low concentrations of volatiles present in the soil at each of Subsites 1A, 1B, and 1D and due to the remote location of these sites with respect to the AFB population and the town of North Edwards, molecular diffusion of volatile organics from undisturbed soil to the air presents no threat to public health.

At Subsite 1C, nitrate concentrations were found in the soil column ranging from 11,400 mg/kg at the surface to 965 mg/kg at a depth of 55 feet beneath one of the nitric acid pits. Ground-water samples collected at ES Well No. 12 located adjacent to Subsite 1C indicate a ground water nitrate concentraion of 0.54 mg/l which is much less than the drinking water standard of 10 mg/l. (Reference 7, Appendix J.) Although ground-water contamination presents no risk to public health at this time, a very low potential exists for leaching of nitrates via rainfall which could percolate downward through the contaminated soil column to the ground water at a depth of 135 feet. The likelihood of percolation of water from the surface to the 135 foot depth is remote since only when infiltration exceeds potential evaporation, and soil moisture exceeds field capacity will significant percolation occur. At Site 1 neither situation will occur. For example, assuming a maximum monthly rainfall event of 5.5 inches and a potential evapotranspiration of 9 inches per month, infiltration cannot exceed evapotranspiration. In addition, only 7 percent of the field capacity will be occupied with soil moisture in the 135 foot soil column at Site 1 even if one conservatively assumes no evapotranspiration, a maximum yearly rainfall of 14 inches (1984) and a 12 percent field capacity.

Although the public health impact resulting from contamination at Site 1 is not presently significant, remedial action should focus on containment, immobilization or removal of contaminants at each of the sites. These options provide better public health protection than the monitoring/site maintenance alternative.

3.1.4.2 Alternative 1-2 - Remove Drums and Immobilize Contaminants

Without remedial action, there are two potential pathways for nitrate and volatile organic migration from the sites: (1) transport by infiltration through the subsurface soils into ground water; and to a

much lesser extent, (2) surface transport by runoff and erosion. Alternative 1-2 will provide adequate protection against surface transport at Subsites 1C and 1D by virtue of the impermeable cap. This alternative will also prevent vertical percolation of rainwater through the nitrate-laden soils at Subsite 1C and soils at Subsite 1D and the attendant migration of contaminants downward towards the ground water. Lateral migration of contaminants requires no control since lateral ground-water movement through the upper 135 feet of subsurface soils is minimal. Removal of the scattered drums, debris, and associated surface soil at each site will eliminate the source of contamination at these sites and minimize the public's health and safety risk.

A certain amount of trucking will accompany each of the alternatives 1-2 to 1-4 considered for Site 1. Statistics have indicated that there is an incidence of risk of accidents accompanying operations of hauling over long distances. (Reference 10, Appendix J.) The National Accident Sampling System (NASS) of the Federal Highway Administration indicates that there is a probability of four accidents per million truck-miles traveled. A spill of drums containing liquid, with the resulting potential for exposure, presents a risk to the public health. However, due to the small number of drums with liquid (30 to 50) to be hauled for alternative 1-2, there is a very low probability for a truck accident.

3.1.4.3 Alternative 1-3 - Remove Drums and Totally Excavate Subsites 1C and 1D

Removal of the scattered drums, debris and associated surface soil at Subsites 1A, 1B, and 1E, and the contaminated soil columns at Subsites 1C and 1D eliminates the source of contamination at Site 1. Consequently, this alternative eliminates the risk of future ground-water contamination.

Due to the relatively high volume of material to be hauled off site under alternative 1-3a, approximately two truck accidents might be expected, according to the statistics of NASS. These spills will present a liability to the U.S. Air Force. However, the liability would be minimal as the very low-level contaminated soil would not pose a significant threat if it were spilled. Under alternative 1-3b, which

involves hauling only Subsite 1D materials off site, no accidents are expected.

3.1.4.4 Alternative 1-4 - Remove Drums/In Situ Leaching of Organics and Nitrates

As with alternatives 1-2 and 1-3, public health and safety risks are minimized since the source of contamination at Subsites 1A, 1E, and 1D (i.e., drums) is removed. In addition, if essentially complete leaching and removal of soil column NO_3 and organics at Subsites 1B, 1C, and 1D can be accomplished, then the risk to public health, due to future ground-water contamination, is considered negligible.

3.1.5 Environmental Assessment

The environmental impacts of each remedial alternative must be addressed in order to identify any necessary mitigation measures. In general, the potential environmental impacts of the remedial action alternatives at all three sites at Edwards AFB are minimal. The sites are all relatively remote and are not considered to be environmentally sensitive areas. There is a general absence of surface water, vegetation, animal life, and cultural resources. Ground-water, air, personnel safety and land use aspects of the environmental assessment are addressed later in this section.

The AFFTC evaluated impacts of the remedial actions in the areas of biology, archaeology, soil erosion, among others. AF Form 813 is provided in Appendix D. No endangered or threatened species are known to occupy the sites. No National Register eligible cultural sites occur within the areas of impact.

3.1.5.1 Alternative 1-1 - Monitoring/Site Maintenance

This alternative has no significant impacts.

3.1.5.2 Alternative 1-2 - Remove Drums and Immobilize Contaminants

Removal of the drums from the site by contract disposal will introduce several potential environmental impacts including vehicular noise, dust and the potential for truck spills. Due to the level of

activity required at Site 1, these problems are not considered significant. The potential for a truck spill is very low. Dust can be controlled by light water spraying. Noise from vehicle traffic will create a minor temporary impact along the haul routes. The affected population is very small.

3.1.5.3 Alternative 1-3 - Remove Drums and Totally Excavate Subsites 1C and 1D

Due to the large number of truckloads of soil to be hauled off site, this alternative presents a higher potential for noise, vehicular dust and truck spills than the other alternatives for Site 1. In addition, although volatilization of organic compounds in the soil column is more likely due to excavation at Subsites 1C and 1D, the anticipated ambient concentration of volatiles is expected to be of no concern due to the low levels present in the soil, the wind dispersion factor, and the long distance to populated areas. The land spreading of nitrate-containing soil in a proper location with no ground water (such as Site 2) should not pose any significant impacts. Material should be spread to simulate typical nitrogen fertilizer loadings on the soil.

3.1.5.4 Alternative 1-4 - Remove Drums/In Situ Leaching of Organics and Nitrates

In addition to those environmental impacts related to drum removal, which are common to alternatives 1-2 and 1-3, this alternative may also generate low-level volatile air emissions with the treatment system's air stripping unit. The low level of volatiles stripped will not present an air problem at this location due to low concentrations, huge dilution ratios, and the site's remote location.

3.1.6 Land Use Restrictions

It is desirable to have land use restrictions for the identified sites following implementation of Phase IV remedial actions for the following reasons: (1) to provide the continued protection of human health, welfare, and the environment; (2) to assure that the contaminant migration is not promoted through improper land uses; (3) to facilitate the compatible development of future U. S. Air Force facilities; and (4)

to allow for identification of property which may be proposed for excess or outlease.

The recommended guidelines for land use restrictions for Site 1 at Edwards AFB are presented in Table 3.4. A description of the land use restriction guidelines is presented in Table 3.5.

3.1.7 Health and Safety Requirements

The operations associated with the various remedial action alternatives at Site 1 pose risks to the site cleanup personnel. These risks are primarily a result of exposure to waste materials. The hazards associated with each alternative and the health and safety measures required to prevent worker exposure and injury are presented in Table 3.6.

3.1.8 Long-Term Liability

Each remedial action alternative proposed at Site 1 has some positive impact on reducing the long-term environmental risk and liability associated with Site 1. The anticipated long-term liability associated with each remedial alternative is an important factor in selecting the best option. Liabilities associated with any site may be divided into three categories: site cleanup, area cleanup, and property damage/personal injury. Each alternative will be discussed with respect to these categories.

3.1.8.1 Alternative 1-1 - Monitoring/Site Maintenance

If nitrates and volatile organics from Site 1 reach the ground water and migrate towards existing water supply wells, a substantial long-term liability exists as a result of: (a) site cleanup -- the source of contamination will then have to be either removed or contained, (b) area cleanup -- more expensive ground-water containment, control and/or treatment systems may have to be installed to alleviate contamination outside the site boundaries, and (c) property damage/ personal injury -- contamination of drinking water supplies will result in a threat to public health and will probably be accompanied by litigation.

TABLE 3.4

RECOMMENDED GUIDELINES FOR FUTURE LAND USE RESTRICTIONS AT SITE 1

	Remedial Action	Construction on the Site	Excavation	Well Construction on or Near the Site	Agricultural Use	Silvicultural Use	Water Infiltration (run-on ponding, irrigation)	Recreational Use	Burning or Ignition Source	Disposal Operations	Vehicular Traffic	Material Storage	Housing on or near the Site
1-1	Monitoring/Site Maintenance	R	R	R	R	NA	R	R	R	R	R	R	R
1-2	Remove Drums and Immobilize Contaminants	R	R	R	R	NA	R	R	R	R	R	NR	R
1-3a	Remove Drums and Totally Excavate Sites 1D and 1C (contract disposal)	NR	NR	R	R	NA	NR	NR	NR	NR	NR	NR	NR
1-3b	Remove Drums and Totally Excavate Sites 1C and 1D (on-site disposal)	NR	NR	R	R	NA	NR	NR	NR	NR	NR	NR	NR
1-4	Remove Drums/ In Situ Leaching of Nitrates and Organics	NR	NR	R	R	NA	NR	NR	NR	NR	NR	NR	NR

R: Restriction
NA: Not Applicable
NR: No Restriction

TABLE 3.5

DESCRIPTION OF GUIDELINES FOR LAND USE RESTRICTIONS

Guideline	Description
Construction on the site	Restrict the construction of structures which make permanent (or semipermanent) and exclusive use of a portion of the site's surface.
Excavation	Restrict the disturbance of the cover or subsurface materials.
Well construction on or near the site	Restrict the placement of any wells (except for monitoring purposes) on or within 500 yards of the site. This distance will vary from site to site, based on soil conditions and groundwater flow.
Agricultural use	Restrict the use of the site for agricultural purposes to prevent food chain contamination.
Silvicultural use	Restrict the use of the site for silvicultural uses (root structures could disturb cover or subsurface materials).
Water infiltration	Restrict water run-on, ponding and/or irrigation of the site. Water infiltration could induce contaminant migration.
Recreational use	Restrict the use of the site for recreational purposes.
Burning or ignition sources	Restrict any and all unnecessary sources of ignition, due to the possible presence of flammable compounds.
Disposal operations	Restrict the use of the site for waste disposal operations, whether above or below ground.
Vehicular traffic	Restrict the passage of unnecessary vehicular traffic on the site due to the presence of explosive material(s) and/or an unstable surface.
Material storage	Restrict the storage of any and all liquid or solid materials on the site.
Housing on or near the site	Restrict the use of housing structures on or within a reasonably safe distance of the site.

TABLE 3.6

SITE 1
HEALTH AND SAFETY REQUIREMENTS FOR REMEDIAL ACTION ALTERNATIVES

Remedial Action	Hazard(s)	Health and Safety Requirements
1-1 Monitoring/Site Maintenance	• Low hazard from airborne contaminated dust during high wind conditions	• Restrict work at the site during high wind conditions
1-2 Remove Drums and Immobilize Contaminants	• Spills/explosions from drums • Inhalation of vapors from drums • Skin/eye contact with drum contents • Contact with contaminated soil during excavation	• Spill prevention/contingency plan • Monitor for airborne organics during drum removal • Respiratory/skin/eye protection (Level C)
1-3a Remove Drums and Totally Excavate Soil at Sites 1C, 1D (contract disposal)	• Spills/explosions from drums • Inhalation of vapors from drums • Skin/eye contact with drum contents • Contact with contaminated soil • Injuries associated with excavation	• Spill prevention/contingency plan • Monitor for airborne organics during drum removal • Respiratory/skin/eye protection (Level C) • Safety procedures for heavy equipment use during excavation
1-3b Remove Drums and Totally Excavate Soil at Site 1C, 1D (on-base disposal)	• Spills/explosions and inhalation/skin/eye contact from drum contents • Contact with contaminated soil	• Spill prevention/contingency plan for drum removal • Respiratory/skin/eye protection (Level C) • Safety procedures for heavy equipment use during excavation
1-4 Remove Drums/In Situ Leaching of Nitrates and Organics	• Spills/explosions and inhalation/eye/skin contact from drum contents • Inhalation of volatiles from leachate treatment • Leachate spills • Skin/eye contact with leachate (low hazard)	• Spill prevention/contingency plan for drum removal and leachate treatment • Monitor for airborne organics during drum removal • Prevent worker exposure to air-stripper emission

3.1.8.2 Alternative 1-2 - Remove Drums and Immobilize Contaminants

This alternative minimizes the long-term liability associated with Site 1 because the source of contaminants is controlled (via drum removal and site capping). As long as the land use restrictions are enforced and proper long-term maintenance of the cap is implemented, this alternative presents minimal long-term liability for Site 1. However, new liability is acquired through use of an off-site contract disposal area. This liability can be minimized by careful screening and selection of the contract disposal site to ensure that only a secure site is used.

3.1.8.3 Alternative 1-3 - Remove Drums and Totally Excavate Subsites 1C and 1D

Due to the complete removal of contaminants at Site 1 under this alternative, no long-term liability is anticipated other than that associated with the contract disposal site.

3.1.8.4 Alternative 1-4 - Remove Drums/In Situ Leaching of Nitrates and Organics

Due to the complete removal of contaminants at Site 1 under this alternative, no long-term liability is anticipated other than that associated with the contract disposal site.

3.1.9 Community Relations

For each alternative, the local community must be kept informed of the Phase IV remedial actions prior to, during, and following cleanup and construction. Essentially, each of the alternatives will require a similar level of community relations. These activities should include:

- Progress reports on Phase IV
- Public meetings
- Articles in the Edwards AFB and local newspapers

Information disseminated by the community relations program should include the ultimate goal of the program, duration of construction activity, and what can be expected regarding traffic, noise, etc.

Included communities should be the AFB, and the towns of Rosamond, North Edwards, Mohave, and Boron and the cities of Lancaster and Palmdale.

3.1.10 Alternative Cost Analysis

Comparative capital and O&M costs have been estimate for each remedial action alternative for Site 1. The major assumptions associated with each alternative are listed in Table 3.7 along with the associated capital and O&M costs.

3.1.11 Environmental Monitoring

Each alternative has both short-term (during Phase IV remedial action construction) and long-term (post-closure) monitoring requirements. These requirements are identified in Table 3.8. A detailed monitoring plan is presented in Appendix F.

3.2 SITE 2 - MAIN BASE WASTE DISPOSAL SITE

3.2.1 Alternative Descriptions

The five preferred alternatives for Site 2 are described briefly in Table 3.9. Each alternative at Site 2 includes the installation of three 20-foot deep post-closure lysimeters (see Figure 3.2). These lysimeters are to be monitored, as water is available, for pH, specific conductivity, lead, total chromium, hexavalent chromium, and cyanide.

3.2.1.1 Alternative 2-1 - Monitoring/Site Maintenance

This alternative involves the installation of one up-gradient and two down-gradient lysimeters, filling trenched areas with local soil, and the construction of an up-gradient swale to prevent rainfall run on.

3.2.1.2 Alternative 2-2 - Excavate Trenches/Contract Disposal

This alternative involves excavation of the contaminated soils within the trenches which have concentrations of total chromium of 300 mg/kg or greater or lead greater than 50 mg/kg. The trench locations were defined by the geophysical survey (April 23 - May 2, 1981) and supplemental soil characterization (May 8 - 11, 1984) conducted at Site 2. (See Appendix I.) The contaminated soil will then be hauled to a

TABLE 3.7

SITE 1
ESTIMATED COSTS FOR REMEDIAL ACTION ALTERNATIVES

Remedial Action	Alternative Discription	Key Cost Basis (1), (2)	Total Cost Capital ($)	Total Cost O&M ($/yr)
1-1 Monitoring/Site Maintenance	• Install 9 post-closure monitoring wells (2 up gradient and 7 down gradient) • Install security fence around Sites 1C and 1D	• Well per Figure 3.1 to 200-ft depth	140,000	12,000
1-2 Remove Drums and Immobilize Contaminants	• Remove surface drums at Subsites 1A, 1B, 1D, and 1E and haul to secure contract disposal facility • Excavate debris and associated top soil at Subsites 1A, 1B, and 1E and haul to secure Class I contract disposal facility • Cap Subsites 1C and 1D with synthetic liner and 2 feet of local playa deposits	• 17,500-ft^2 synthetic liner • 1,300 cy of local playa cover • 75 cy of excavated soil at Subsites 1A, 1B, and 1E	440,000	17,000
1-3a Remove Drums and Totally Excavate Soil at Subsites 1C and 1D	• Remove surface drums and soils at Subsites 1A, 1B, 1D, and 1E and haul to secure Class I contract disposal facility • Excavate NO_3 contaminated soil at Subsite 1C and soil at 1D to 100-ft depth and haul to contract disposal facility	• 51,600 cy soil excavated at Subsites 1D and 1C • Excavated pit at 1C and 1D refilled with local soil	5,900,000	8,000
1-3b Remove Drums and Totally Excavate Soil at Subsites 1C and 1D	• Remove surface drums and associated soils at Subsites 1A, 1B, 1D, and 1E and haul to off-site disposal • Excavate NO_3 contaminated soil at Subsite 1C to 100-ft depth and haul to on-site disposal • Excavate contaminated soil at Subsite 1D to 100-ft depth and haul to off-site contract disposal	• 11,700 cy soil excavated at Subsite 1D hauled to secure Class I contract disposal site • Excavated pit at 1C and 1D refilled with local soil	1,850,000	8,500
1-4 Remove Drums/In Situ Leaching of Nitrates and Organics	• Remove surface drums at Subsites 1A, 1B, 1D, and 1E and haul to secure Class I contract disposal facility • Install well points and percolation pond at Subsites 1B, 1C, and 1D • Treat leached water using on-site air stripping, biological denitrification and carbon adsorption treatment system	• Two 4-in. well points to 150-ft depth • 20 gpm air stripper, denitrification unit and carbon adsorption columns	950,000	250,000

(1) Well costs and security costs are same for all alternatives.
(2) All contract disposal assumed at Kettleman Hills Site approximately 215 miles from Edwards AFB.

TABLE 3.8

SUMMARY OF SITE 1 PREFERRED ALTERNATIVES
ENVIRONMENTAL MONITORING

	Remedial Action	Alternative Discription	Short-Term (1) Monitoring	Long-Term (2) Monitoring
1-1	Monitoring/Site Maintenance	• Install 9 post-closure monitoring wells (2 up gradient and 7 down gradient) • Install security fence around Subsites 1C and 1D	None	Quarterly sampling and analysis for first two years. If no contamination is detected, then annually thereafter for 30 years.
1-2	Remove Drums and Immobilize Contaminants	• Remove surface drums and associated soils at Subsites 1A, 1B, 1D, and 1E and haul to secure Class I contract disposal facility • Cap Subsites 1C and 1D with synthetic liner and local playa deposits	OVA and HNU monitoring during drum removal and soil excavation	Quarterly sampling and analysis for first two years. If no contamination is detected, then annually thereafter for 30 years.
1-3a	Remove Drums and Totally Excavate Soil at Subsites 1C and 1D	• Remove surface drums and associated soils at Subsites 1A, 1B, 1D, and 1E and haul to secure Class I contract disposal facility • Excavate NO_3 contaminated soil at Site 1C and soil at 1D to 100' depth and haul to contract disposal facility	OVA and HNU monitoring during drum removal and soil excavation	Quarterly sampling and analysis for first two years. If no contamination is detected, then annually thereafter for 30 years.
1-3b	Remove Drums and Totally Excavate Soil at Subsites 1C and 1D	• Remove surface drums and associated soils at Subsites 1A, 1B, 1D, and 1E and haul to off-site disposal • Excavate NO_3 contaminated soil at Site 1C to 100' depth and haul to on-site disposal • Excavate contaminated soil at Site 1D to 100' depth and haul to contract disposal site	OVA and HNU monitoring during drum removal and soil excavation	Quarterly sampling and analysis for first two years. If no contamination is detected, then annually thereafter for 30 years.
1-4	Remove Drums/In Situ Leaching of Nitrates and Organics	• Remove all surface drums at Subsites 1A, 1B, 1D, and 1E and haul to secure Class I contract disposal facility • Install well points and percolation pond at Subsites 1B, 1C, and 1D • Treat leached water using on-site air stripping, biological denitrification and carbon adsorption treatment system	OVA and HNU monitoring during drum removal and soil excavation	Quarterly sampling and analysis for first two years. If no contamination is detected, then annually thereafter for 30 years.

(1) During Phase IV remedial action construction activities.
(2) Post-closure monitoring for TOC, pH, conductivity, VOA, and fuel oils at Subsites 1A/1E. Monitoring for TOC, pH, conductivity, VOA, nitrates, and fuel oils at Subsites 1B, 1C, and 1D.

TABLE 3.9

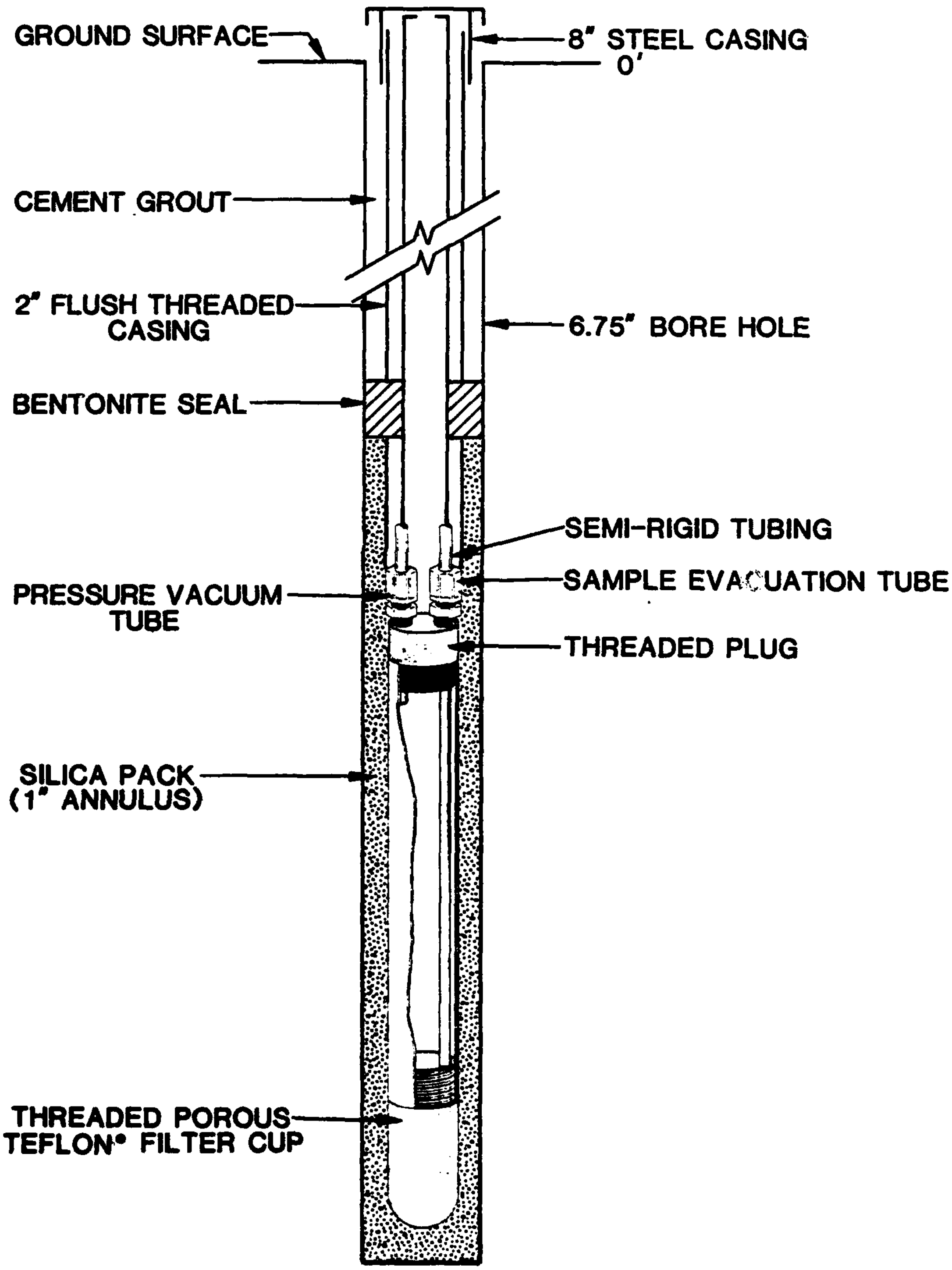
SITE 2
PREFERRED REMEDIAL ACTIONS

Alternative Number		Alternative Description
2-1	Monitoring/Site Maintenance[1]	• Install three post-closure lysimeters (one up gradient and two down gradient)
2-2	Excavate Trenches/ Contract Disposal	• Excavate contaminated soil in trenches and haul to secure Class I contract disposal facility • Backfill trenches with local soil and grade site
2-3	Immobilize Contaminants with Cap	• Grade site for liner placement • Cap site with synthetic liner and two-foot playa cap
2-4	Construct Slurry Wall/ Install Drain and Collection System	• Construct bentonite slurry wall to bedrock on down gradient, south side of Site 2 • Install drain and collection system up gradient of slurry wall • Collect and evaporate extracted water in lined basin
2-5	Cap Site/Construct Slurry Wall Up Gradient	• Grade site for liner placement • Cap site with synthetic liner and two-foot clay cap • Construct bentonite slurry wall to bedrock up gradient of site

(1) All alternatives contain post-closure, ground-water monitoring.

EDWARDS AFB

LYSIMETER DESIGN FOR SITE 2



(NOT TO SCALE)

REFERENCE: TIMCO MANUFACTURING COMPANY

secure Class I off-site contract disposal facility. Following excavation, the site will be graded to natural contours. Finally, the heavy equipment used for earth moving will be decontaminated before leaving the site. The decontamination unit will consist of a steam cleaner and a temporary pool to collect contaminated wash water to hold until evaporation. Residues from the evaporation process will be hauled to a secure Class I disposal site.

Alternative 2-2 can be implemented within a few months and requires minimal long-term O&M activities (i.e., ground-water sampling and analysis).

3.2.1.3 Alternative 2-3 - Immobilize Contaminants with Cap

This alternative simply involves the placement of a synthetic 36-mil reinforced liner over the contaminated trench areas at Site 2. The cap area will have to be graded initially to remove surface vegetation and prepare the surface for liner placement. Once the liner is placed, playa clay will be transported from the Rogers Dry Lake Bed area near Site 1 and compacted to a 2-foot depth on the liner. This cap will be mounded to direct water off the cap and prevent ponding. Finally, a 3-inch layer of crushed gravel will be placed on the clay to prevent wind erosion and wildlife burrowing. Precipitation runoff will be diverted by sloping cap and liner surfaces to two drainage ditches to be constructed on the east and west side of the cap area.

Ongoing responsibilities for alternative 2-3 will include ground-water sampling and analysis and periodic inspection and maintenance of the cover, drainage and security system.

3.2.1.4 Alternative 2-4 - Construct Slurry Wall/Install Drain and Collection System

Alternative 2-4 consists of the installation of a cement/bentonite slurry wall along the down-gradient side (south) of Site 2 approximately 625 feet long and 21 feet deep (depth of bedrock). Any shallow percolating water or seasonal ground water that drains towards the wall from the site will be collected by a gravel drain installed at a depth of 21 feet along the up-gradient side of the slurry wall. The collected water

will be collected in a sump and pumped to a lined evaporation basin. Residue from this basin will be hauled to a secure disposal site.

It should be noted that the overall feasibility of this slurry wall alternative is questionable. There is insufficient data to determine the integrity of the bedrock; it may be fractured in certain areas below the site. To ensure the integrity of the bedrock, it would be necessary to take core samples to determine fracturing and permeability. If the rock is fractured, the slurry wall would be ineffectual.

Ongoing maintenance is significant for this alternative due to the O&M required for the collection system.

3.2.1.5 Alternative 2-5 - Cap Site/Construct Slurry Wall Up Gradient

This alternative involves the installation of a cement/bentonite slurry wall along the up-gradient side (north) of Site 2 approximately 1,000 feet long and 21 feet deep to divert transient water away from the site. In addition, a cap as described in alternative 2-3 will be constructed.

Ongoing responsibilities include ground-water sampling and analysis, inspection and maintenance of the cover and drainage systems.

3.2.2 Engineering Feasibility

3.2.2.1 Alternative 2-1 - Monitoring/Site Maintenance

Without remedial action, there is only one potential pathway for chromium and lead migration from Site 2 and that is transport by infiltration through the subsurface soils into ground water. The major concern regarding this site is the potential for contaminants migrating toward the aquifer along the shores of Rogers Dry Lake Bed approximately 3,500 feet away. The no action alternative will not prevent continued migration of contaminants from the site; however, by monitoring down gradient any contamination from the site will be detected.

3.2.2.2 Alternative 2-2 - Excavate Trenches/Contract Disposal

Based on historical evidence of disposal practices a geophysical survey was conducted at Site 2 (April 23-May 2, 1981). A number of trenches were defined by the geophysical survey as disturbed areas

possibly used for burial of liquid wastes. These areas coincided well with existing signs marking disposal locations. Subsequent soil samples collected from suspected areas of disturbance and possible waste disposal showed generally low contaminant levels (less than 20 mg/kg) throughout the site. Appendix I provides a detailed discussion of the geophysical and sampling results.

Under this alternative, contaminated soils would be excavated and hauled to a secure Class I disposal facility. A number of secure hazardous waste disposal sites exist within 250 miles of Edwards AFB (Appendix C). Alternative 2-2 can be implemented within three to four months. In addition, this alternative removes the source of further contamination.

3.2.2.3 Alternative 2-3 - Immobilize Contaminants with Cap

This alternative has been demonstrated for control of vertical infiltration of rainwater through the soils and the attendant migration of contaminants downward. It does not, however, prevent the migration of contaminants by lateral, seasonal ground-water movement through the subsurface soils above bedrock, should such migration exist.

Local playa clay deposits, although possessing low permeability, cannot be used alone as a cap at this site because of the likelihood of cracking in the arid environment at Edwards AFB. Therefore, the playa deposit will be used to provide both a secondary liner system and protection from UV light for a the synthetic liner underneath. In addition, a gravel layer placed on the playa clay will prolong the life of the cap by reducing wind erosion and preventing wildlife burrowing.

3.2.2.4 Alternative 2-4 - Construct Slurry Wall/Install Drain Collection System

Use of a cement/bentonite slurry wall, installed to bedrock on the south side of Site 2, will be a means of preventing down-gradient migration of seasonal ground water. The site wastes (primarily chromates and tetraethyl lead) are known to be compatible with and will not degrade a cement/bentonite type slurry wall system. From a construction standpoint, either a vibratory beam slurry wall or a conventional slurry wall could be installed at Site 2, although the vibratory beam approach

may produce a less permeable barrier. In order to prevent seepage of seasonal ground water around the barrier wall, a gravel drain will be installed up gradient of the wall to divert collected water to a sump. This water will then be pumped to a lined impoundment for evaporation. Residue from the impoundment will be hauled to a secure dispcsal site.

3.2.2.5 Alternative 2-5 - Cap Site/Construct Slurry Wall Up Gradient

This alternative consists of installing a cement/bentonite slurry wall to bedrock up gradient of the waste trenches at Site 2. This barrier will force any seasonal ground-water flow around the wastes and prevent lateral migration of contaminants due to seasonal ground-water flow.

In order to prevent vertical migration of contaminants, resulting from infiltration of rainwater, a site cap is required. The cap to be used for this alternative is the same as with alternative 2-3.

This alternative is relatively easy to implement and relatively maintenance free.

3.2.3 Regulatory and Permit Requirements

A summary of permits and regulations for the preferred types of remedial action activities at Edwards AFB was presented in Table 3.2. Specific permit requirements for Site 2 alternatives are discussed below.

3.2.3.1 Alternative 2-1 - Monitoring/Site Maintenance

No specific permits are required under this alternative although, as with all Site 2 alternatives, the frequency and duration of post-closure lysimeter sampling and analysis must be approved by the Lahonton RWQCB.

3.2.3.2 Alternative 2-2 - Excavate Trenches/Contract Disposal

The contract haulers are required to have both an EPA and California DHS permit for hazardous waste hauling. In addition, the contract disposal sites require a TSD permit from the California DHS.

3.2.3.3 Alternative 2-3 - Immobilize Contaminants with Cap

No specific permits are required.

3.2.3.4 Alternative 2-4 - Construct Slurry Wall/Install Extraction Well

No specific permits are required.

3.2.3.5 Alternative 2-5 - Cap Site/Construct Slurry Wall Up Gradient

No specific permits are required.

3.2.4 Public Health Analysis

3.2.4.1 Alternative 2-1 - Monitoring/Site Maintenance

The only possible public health risk at Site 2 is potential contaminant migration toward the aquifer along the shores of Rogers Dry Lake which is about 3,500 feet away. Even if contaminants reached the edge of this aquifer, it is over two miles to the nearest production well. The contamination identified in soil samples at Site 2 is relatively low overall. Cyanide was not detected over 0.1 mg/kg. Total chromium concentrations were generally less than 20 mg/kg with a high of 82 mg/kg. Nitrate concentrations were generally less than 20 mg/kg with a high of 93 mg/kg. Lead was found at less than 10 mg/kg except for one sample at 41 mg/kg. This level of contamination is not considered hazardous according to the total threshold limit concentrations criteria contained in the "California Assessment Manual for Hazardous Wastes." The risk to health of the public or site workers due to these levels and types of contamination is extremely low. Assuming a soil permeability of 1×10^{-4} cm/sec, an effective porosity of 0.12 and a bedrock slope of 2 percent, it will take 210 years for seasonal ground water to percolate along the surface of bedrock 3,500 feet to the edge of Rogers Dry Lake bed. This assumes that seasonal ground water is generated at the site. During the past year, no water has been detected at the lysimeter located down gradient of Site 2.

3.2.4.2 Alternative 2-2 - Excavate Trenches/Contract Disposal

Removal of the contaminated soils from the trench locations at Site 2 will remove the source of contamination at these sites and minimize the potential for continued migration of low-level contaminants.

Less than 100,000 truck-miles of contract disposal hauling is anticipated for Site 2. Due to the small volume of material to be hauled, there is a low probability of a truck accident during hauling operations based on statistics provided by NASS.

3.2.4.3 Alternative 2-3 - Immobilize Contaminants with Cap

Alternative 2-3 will provide adequate protection against surface transport at Site 2 by virtue of the impermeable cap. This alternative will also prevent vertical percolation of rainwater and the attendant migration of contaminants down gradient. Due to the gradual slope of the site, lateral migration of contaminants as a result of seasonal water movement is still possible. This alternative provides less risk to public health than alternative 1-1 because the major source of water for contaminant movement at the site results from rain infiltration.

3.2.4.4 Alternative 2-4 - Construct Slurry Wall/Install Drain Collection System

This alternative affords total containment of Site 2 contaminants. There is little risk of ground-water contamination from Site 2 if a slurry wall and drain system are installed down gradient.

3.2.4.5 Alternative 2-5 - Cap Site/Construct Slurry Wall Up Gradient

As with Alternative 2-4, this alternative affords total containment of Site 2 contaminants.

3.2.5 Environmental Assessment

The environmental impacts of each remedial alternative must be addressed in order to identify any necessary mitigation measures. In general, Site 2 is relatively remote and is not considered to be an environmentally sensitive area. There is a general absence of surface water and ground water. Ground-water, air, personnel safety and land use aspects of the environmental assessment are addressed elsewhere in

this section. AFFTC evaluated impacts of the remedial actions in the areas of biology, archeology, soil erosion, and others. AF Form 813's are provided in Appendix D. No endangered or threatened species are known to occupy the sites. No National Register eligible sites occur within the area of impact.

3.2.5.1 Alternative 2-1 - Monitoring/Site Maintenance

This alternative may contribute to down-gradient soil contamination as discussed in the public health analysis. However, the possibility of ground-water contamination is considered extremely remote.

3.2.5.2 Alternative 2-2 - Excavate Trenches/Contract Disposal

Removal of contaminated soils from the site by contract disposal will introduce several potential environmental impacts including vehicular noise, dust and the potential for truck spills. Due to the level of activity required at Site 2, these problems are not considered significant. The potential for a truck spill is very low. Dust can be controlled by light water spraying.

Volatilization of organic compounds in the soil column is likely due to excavation at Site 2. However, the anticipated ambient concentration of volatiles is expected to be of no concern due to the low levels present in the soil (tetraethyl lead less than 3 mg/kg), the wind dispersion factor and the long distance to populated areas.

3.2.5.3 Alternative 2-3 - Immobilize Contaminants with Cap

Due to the amount of playa clay to be hauled to Site 2 from Rogers Dry Lake Bed, vehicular noise and dust could create a temporary local impact. This impact can be minimized by using light water sprays to control dust, by routing trucks around populated areas where possible, and by requiring proper noise suppression equipment on the vehicles.

3.2.5.4 Alternative 2-4 - Construct Slurry Wall/Install Drain Collection System

The primary environmental impact will be noise during placement of the slurry wall. This is a temporary impact occurring over one-half mile from base buildings. Mitigation can be achieved by requiring proper noise suppression equipment on the construction machinery.

3.2.5.5 Alternative 2-5 - Cap Site/Construct Slurry Wall Up Gradient

The environmental impacts are similar to alternatives 2-3 and 2-4.

3.2.6 Land Use Restrictions

The recommended land use restriction guidelines for Site 2 are presented in Table 3.10.

3.2.7 Health and Safety Requirements

The health and safety requirements associated with Site 2 alternatives are presented in Table 3.11.

3.2.8 Long-Term Liability

Each remedial action alternative proposed at Site 2 has some positive impact on reducing the long-term environmental risk and liability. However, even the liability associated with the monitoring/site maintenance alternative at Site 2 is considered minimal based on the public health analysis discussed previously.

3.2.9 Community Relations

For each alternative, the local community must be kept informed of the Phase IV remedial actions prior to, during, and following cleanup and construction. Essentially, each of the alternatives will require a similar level of community relations. These activities should include:

- Progress reports on Phase IV
- Public meetings
- Articles in the Edwards AFB and local papers

The information disseminated by the community relations program should include the ultimate goal of the program, duration of construction activity, and what can be expected regarding traffic, noise, etc.

Included communities should be the AFB, and the towns of Rosamond, North Edwards, Mohave, Boron, and cities of Lancaster and Palmdale.

TABLE 3.10

RECOMMENDED GUIDELINES FOR FUTURE LAND USE RESTRICTIONS AT SITE 2

	Remedial Action	Construction on the Site	Excavation	Well Construction on or Near the Site	Agricultural Use	Silvicultural Use	Water Infiltration (run-on ponding, irrigation)	Recreational Use	Burning or Ignition Source	Disposal Operations	Vehicular Traffic	Material Storage	Housing on or near the Site
2-1	Monitoring/Site Maintenance	R	R	R	R	NA	R	R	NR	R	R	NA	R
2-2	Excavate Trenches/ Contract Disposal	NR	NR	R	R	NA	R	R	NR	NR	R	NA	R
2-3	Immobilize Contaminants with Cap	R	R	R	R	NA	R	R	NR	R	R	NA	R
2-4	Construct Slurry Wall/Install Drain and Collection System	R	R	R	R	NA	R	R	NR	NR	R	NA	R
2-5	Cap Site/Construct Slurry Wall Up Gradient	R	R	R	R	NA	R	R	NR	R	R	NA	R

R: Restriction
NA: Not Applicable
NR: No Restriction

TABLE 3.11

SITE 2
HEALTH AND SAFETY REQUIREMENTS FOR REMEDIAL ACTION ALTERNATIVES

Remedial Action	Hazard(s)	Health and Safety Requirements
2-1 Monitoring/Site Maintenance	• Low hazard from airborne contaminated dust during high wind conditions	• Restrict work at the site during high wind conditions
2-2 Excavate Trenches/ (contract disposal)	• Skin/eye contact and inhalation hazard from contaminated soil	• Monitor airborne contaminants and provide adquate respiratory protection (Level C) • Skin/eye protection from excavated soil
2-3 Immobilize Contaminants with Cap	• Low hazard from airborne contaminants during high wind conditions • Low hazard of skin/eye contacted with contaminated soil	• Restrict work at the site during high wind conditions • Restrict unnecessary entry into contaminated areas
2-4 Construct Slurry Wall/Install Drain and Collection System	• Low hazard of skin/eye contract with contaminated ground water and removed contaminants	• Prevent contact with contaminated ground water and removed contaminants
2-5 Cap Site/Construct Slurry Wall Up Gradient	• Low hazard from airborne contaminants during high wind conditions • Low hazard of skin/eye contact with contaminated soil	• Restrict work at the site during high wind conditions • Restrict unnecessary entry into contaminated areas

3.2.10 Alternative Cost Analysis

Comparative capital and O&M costs have been estimated for each remedial action for Site 2. The major assumptions associated with each alternative are listed in Table 3.12 along with the associated capital and O&M costs.

3.2.11 Environmental Monitoring

Each alternative will have both short-term (during Phase IV remedial action construction) and long-term (post-closure) monitoring requirements. These requirements are essentially the same for each. During the remedial construction activity, organic vapor analyzer (OVA) and HNU monitoring will be conducted. During the post-closure period, each of the lysimeters will be sampled and analyzed for pH, conductivity, lead, total chromium, hexavalent chromium and cyanide. These are typical indicators of the presence of plating solutions, the main type of waste disposed at the site. A detailed post-closure monitoring plan is presented in Section 5 and Appendix F.

3.3 SITE 5 - SOUTH BASE UNDERGROUND WASTE POL STORAGE TANKS

3.3.1 Alternative Descriptions

The four preferred alternatives for Site 5 are summarized in Table 3.13. Each alternative at Site 5 includes the installation of four additional monitoring wells in the deep aquifer to complement the two already installed in the shallow aquifer and the four in the deep aquifer. Figure 3.3 shows the locations of these wells. The wells will be drilled to a depth of 100 feet and be fitted with 40 feet of PVC slotted screen. Figure 3.4 shows a cross section of these wells. The wells will be sampled on a routine basis for total organic carbon (TOC), volatile organic compounds, lead and fuel oils.

3.3.1.1 Alternative 5-1 - Monitoring/Site Maintenance

This alternative involves no action other than installation of one up-gradient and three down-gradient wells in the deep aquifer.

TABLE 3.12

SITE 2
ESTIMATED COSTS FOR REMEDIAL ACTION ALTERNATIVES

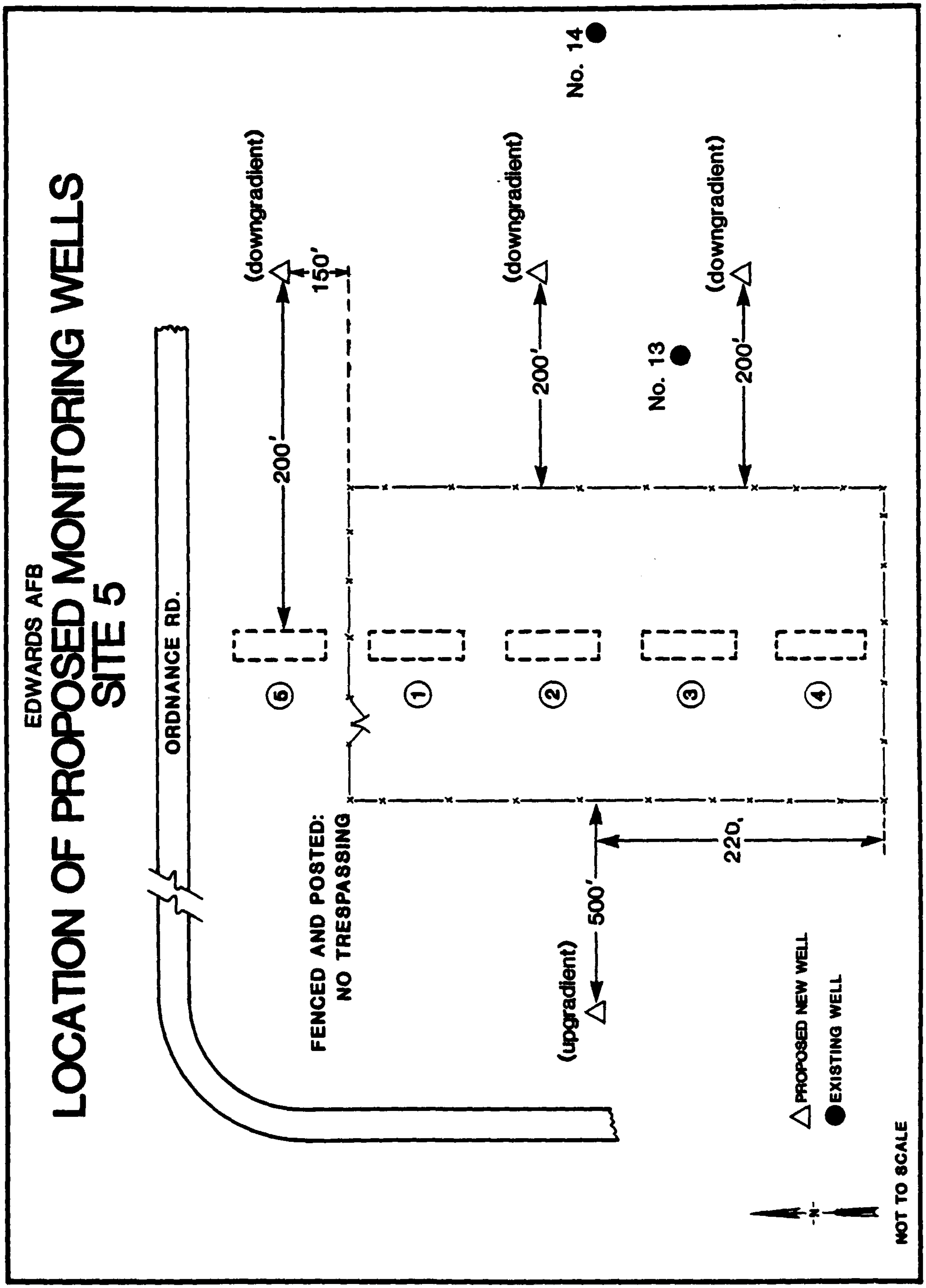
	Remedial Action	Alternative Discription	Key Cost Basis (1), (2)	TOTAL COST Capital ($)	O&M ($/yr)
2-1	Monitoring/Site Maintenance (1)	• Install 3 post-closure lysimeters (1 up gradient and 2 additional down gradient)	• Surface grading to prevent run-on • Three lysimeters installed to depth of 20 feet (bedrock) • Annual monitoring for pH, conductivity, lead, total chromium, hexavalent chromium, cyanide, nitrate	30,000	2,000
2-2	Excavate Trenches/ Contract Disposal	• Excavate contaminated soil in trenches and haul to secure Class I contract disposal facility • Backfill trenches with local soil and grade site	• 7,000 sq. ft. of trenches • 21-foot depth excavation • Contract disposal at Kettleman Hills site about 215 miles from Edwards AFB	656,000	1,500
2-3	Immobilize Contaminants with Cap	• Grade site for liner placement • Cap site with synthetic liner and two-foot playa cap	• Three acres of cap	585,000	10,000
2-4	Construct Slurry Wall/ Install Drain and Collection System	• Construct bentonite slurry wall to bedrock on down-gradient, south side of Site 2 • Install drain and collection system up gradient of slurry wall • Collect and evaporate extracted water in lined basin	• Slurry wall 625 feet long to 21-foot depth	205,000	15,000
2-5	Cap Site/Construct Slurry Wall Up Gradient	• Grade site for liner placement • Cap site with synthetic liner and two-foot playa cap • Construct bentonite slurry wall to bedrock up gradient of site	• Three acres of cap • Slurry wall 1,000 feet long to 21-foot depth	760,000	13,000

(1) Well costs and security costs are same for all alternatives.
(2) All contract disposal assumed at Kettleman Hills Site approximately 215 miles from Edwards AFB.

TABLE 3.13

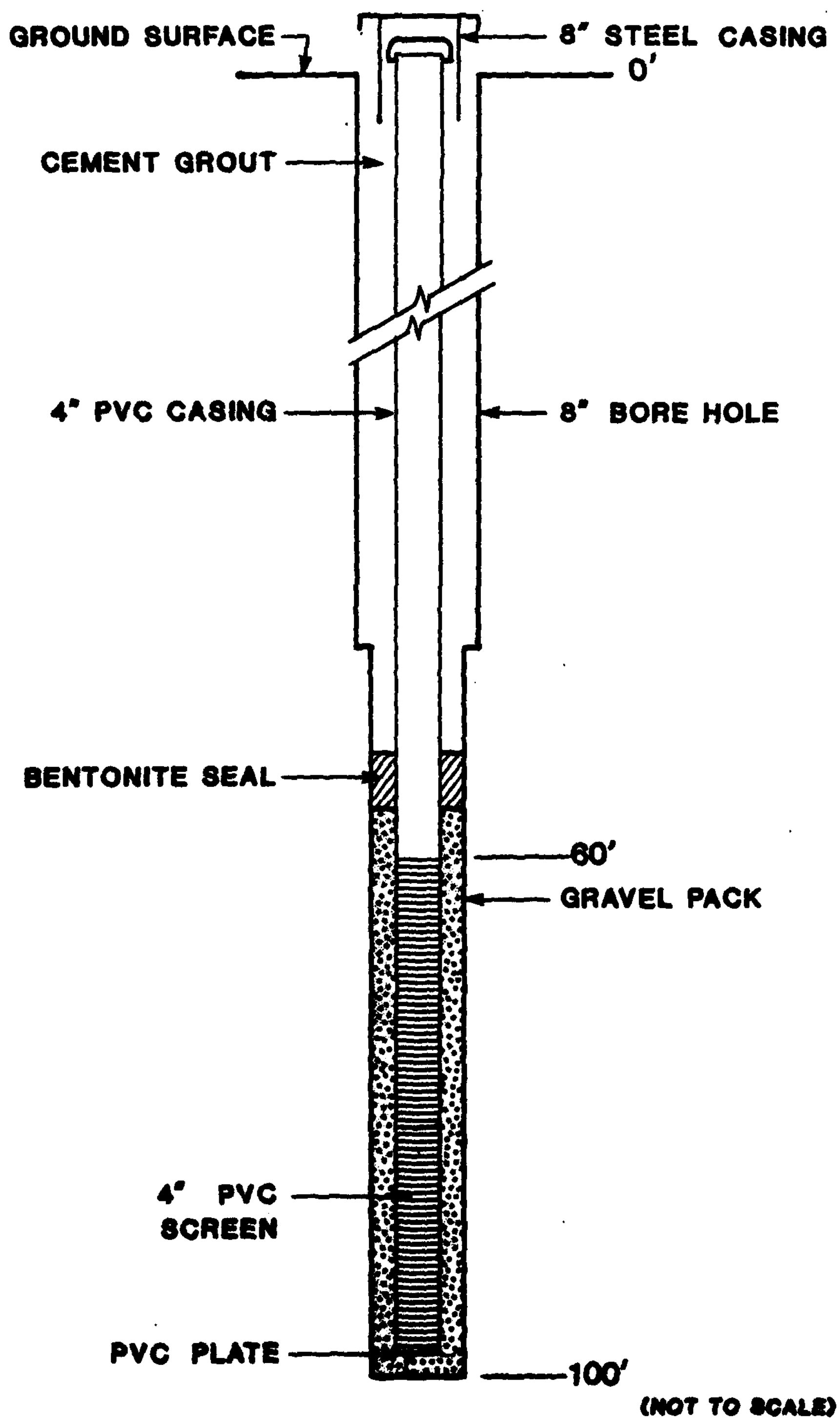
SITE 5
PREFERRED REMEDIAL ACTION ALTERNATIVES

Alternative Number	Alternative Discription
5-1 Monitoring/Site Maintenance	° Install four post-closure monitoring wells (one up gradient and three down gradient in the deep aquifer)
5-2 Close Tanks in Place	° Empty tanks (salvage contents or dispose at Class I site) ° Steam clean insides of tanks ° Excavate to expose tank tops ° Rip open tops and fill with clean native soil ° Backfill and grade
5-3 Close Tanks and Cap Site	° Empty tanks (salvage contents or dispose at Class I site) ° Steam clean insides of tanks ° Excavate to expose tank tops ° Rip open tops and fill with clean native soil ° Backfill and grade ° Cap site with 30-mil liner, 2 feet of clay, and 6 inches of gravel
5-4 Remove Tanks and Contaminated Soil	° Empty tanks ° Remove and clean tanks ° Haul to base sanitary landfill ° Backfill and grade


EDWARDS AFB
LOCATION OF PROPOSED MONITORING WELLS
SITE 5
ORDNANCE RD.
FENCED AND POSTED:
NO TRESPASSING
(upgradient)
500'
220'
200'
150'
(downgradient)
200'
(downgradient)
200'
(downgradient)
No. 13
No. 14
6
1
2
3
4
PROPOSED NEW WELL
EXISTING WELL
N
NOT TO SCALE

EDWARDS AFB

MONITORING WELL DESIGN FOR SITE 5



3.3.1.2 Alternative 5-2 - Close Tanks in Place

Alternative 5-2 consists of pumping out the three 50,000-gallon tanks still in use and salvaging the waste petroleum, oils, and lubricants (POL). The tanks would then be steam cleaned to remove residue and the tank areas excavated to expose the tank tops. The tops would then be ripped open and the tanks filled with clean sand or soil. The excavations would be backfilled and the four new monitoring wells installed.

3.3.1.3 Alternative 5-3 - Close Tanks and Cap the Site

This alternative is identical to alternative 5-2 except that a cap, consisting of a 36-mil synthetic liner covered with 2 feet of clay and 3 inches of gravel would be placed over the site.

3.3.1.4 Alternative 5-4 - Remove Tanks

This alternative involves the emptying and complete excavation and removal of the five tanks. The tanks could possibly be cleaned, salvaged and sold; however, due to the age of the tanks, it is assumed that they will be cleaned and hauled directly to disposal at the base sanitary landfill. Excavations will be backfilled with native soil. No cap is deemed necessary since the source of contamination has been removed.

3.3.2 Engineering Feasibility

All the alternatives are feasible from an engineering standpoint. The remedial action technology is straightforward and relatively simple involving various combinations of excavation, removal of tanks and soil, capping the site, and installation of monitoring wells.

3.3.3 Regulatory and Permit Requirements

Only alternative 5-1, monitoring/site maintenance is less than favorable from a regulatory standpoint. It will be unacceptable to only pump out the tanks. All other alternatives would be acceptable at this time. No special permits are required; however, approval of the recommended remedial actions by the Lahontan RWQCB, the Kern County Health Department, and the DHS is required.

3.3.4 Public Health Analysis

The only potential health risk at Site 5 is contamination of drinking water supplies, and based on available data, this risk is very low. The nearest water production well is approximately 4,000 feet away. No contamination has been found in either the shallow or deep aquifer at the site, although oil contaminated subsurface soils have been detected down gradient from the site. Once the tanks are emptied and properly buried on site or hauled to disposal, there should be essentially very low risk at this site. This will not be the case, however, if a plume of oil or fuel has already migrated away from the site toward the well, or if contamination from other unknown sources or past spills exist. Ongoing Phase II work should aid in identifying these possible problems.

3.3.5 Environmental Assessment

Environmental impacts associated with Site 5 and proposed remedial actions are minor. The site represents about one acre of desert terrain in the vast expanse of Edwards AFB. The site is essentially devoid of vegetation and animal life, and has been used for underground POL and waste POL storage for 40 years. Application of any of the remedial actions will result in adequate environmental protection with the exception of ground water which was previously addressed under the public health analyses section.

3.3.6 Health and Safety Requirements

The health and safety aspects of the various preferred remedial actions are relatively minor. The health and safety requirements for Site 5 remedial action alternatives are presented in Table 3.14.

3.3.7 Land Use Restrictions

Table 3.15 summarizes the land use restrictions for Site 5 and for each of the remedial actions. Table 3.5, shown previously, describes the land use restriction categories.

3.3.8 Long-Term Liability

Each remedial action alternative proposed at Site 5 has some positive impact on reducing long-term environmental risk and liability. The

TABLE 3.14

SITE 5
HEALTH AND SAFETY REQUIREMENTS FOR REMEDIAL ACTION ALTERNATIVES

Remedial Action	Hazard(s)	Health and Safety Requirements
5-1 Monitoring/Site Maintenance	• Explosion hazard from drilling into underground fuel/oil spills	• Monitor for explosive atmosphere during drilling
5-2 Close Tanks in Place	• Inhalation hazard during steam cleaning of tanks • Spills of tank contents during removal	• Provide monitoring and respiratory protection during steam cleaning • Spill prevention/contingency plan
5-3 Close Tanks and Cap Site	• Inhalation hazard during steam cleaning of tanks • Spill of tank contents during removal	• Provide monitoring and respiratory protection during steam cleaning • Spill prevention/contingency plan
5-4 Remove Tanks and Contaminated Soil	• Spills of tank contents during emptying and tank removal • Skin/eye contact with contaminated soil	• Spill prevention/contingency plan • Provide protective clothing and equipment during tank emptying and soil removal

TABLE 3.15

RECOMMENDED GUIDELINES FOR FUTURE LAND USE RESTRICTIONS AT SITE 5

	Remedial Action	Construction on the Site	Excavation	Well Construction on or Near the Site	Agricultural Use	Silvicultural Use	Water Infiltration (run-on ponding, irrigation)	Recreational Use	Burning or Ignition Source	Disposal Operations	Vehicular Traffic	Material Storage	Housing on or near the Site
5-1	Monitoring/Site Maintenance	R	R	R	NA	NA	R	R	R	R	NR	NR	R
5-2	Close Tanks in Place	R	R	R	NA	NA	R	R	R	R	NR	NR	R
5-3	Close Tanks and Cap Site	R	R	R	NA	NA	R	R	R	R	R	NR	R
5-4	Remove Tanks and Contaminated Soil	NR	NR	R	NA	NA	NR	NR	R	R	NR	NR	R

R: Restriction
NA: Not Applicable
NR: No Restriction

liability associated with each remedial alternative is an important factor in selecting the best option. Liabilities may be divided into three categories: site cleanup, area cleanup, and property damage/personal injury. Each alternative will be discussed with respect to these categories.

3.3.8.1 Alternative 5-1 - Monitoring/Site Maintenance

If fuels and/or oils from Site 5 reach the ground water and migrate towards the existing water supply well, a substantial long-term liability exists as a result of: (a) site cleanup -- the source of contamination will then have to be either removed or contained, (b) area cleanup -- more expensive ground-water containment, control and/or treatment systems may have to be installed to alleviate contamination outside the site boundaries, and (c) property damage/personal injury -- contamination of drinking water supplies will result in a threat to public health and will probably be accompanied by litigation.

3.3.8.2 Alternatives 5-2, 5-3, and 5-4

Because these alternatives result in the removal of the source of contamination, the long-term liability is very low.

3.3.9 Community Relations

Site 5 is very remote from any population. Community relations activities at this site could be incorporated in a general program for all the sites comprised of the following activities:

- Articles in the Edwards AFB and local newspapers
- Presentations to groups and organizations
- Public meetings

Included communities should be the AFB, and the towns of North Edwards, Boron, Rosamond, Mohave, and cities of Lancaster and Palmdale.

3.3.10 Alternative Cost Analysis

Comparative capital and O&M costs have been estimated for each remedial action alternative for Site 5. The major assumptions associated with each alternative are listed in Table 3.16 along with the associated capital and O&M costs.

TABLE 3.16

SITE 5

ESTIMATED COSTS FOR REMEDIAL ACTION ALTERNATIVES

Remedial Action	Alternative Discription	Key Cost Basis (1), (2)	Total Cost Capital ($)	Total Cost O&M ($/yr)
5-1 Monitoring/Site Maintenance	• Install 4 post-closure monitoring wells (3 down gradient and 1 up gradient in shallow aquifer)	• Four new monitoring wells installed in shallow aquifer to 75 feet • Long-term monitoring quarterly for: fuels and oils	4,000	10,500
5-2 Close Tanks in Place	• Empty tanks (salvage contents or dispose at Class I site) • Steam clean insides of tanks • Excavate to expose tank tops • Rip open tops and fill with clean native soil • Backfill and grade	• Five 50,000-gal. tanks • Tanks buried 6-feet below grade • AF to pay separtely for emptying tanks and salvaging contents • Local soil used for backfill	80,000	10,000
5-3 Close Tanks and Cap Site	• Empty tanks (salvage contents or dispose at Class I site) • Steam clean insides of tanks • Excavate to expose tank tops • Rip open tops and fill with clean native soil • Backfill and grade • Cap site with 30 mil liner, 3 feet of clay, and 6 inches of gravel	• Include costs for Alternatives 5-1 and 5-2 • 44,000 sq. ft. for cap • Local clay used for liner	200,000	12,000
5-4 Remove Tanks	• Empty tanks • Remove and clean tanks • Haul to base sanitary landfill • Backfill and grade	• Tanks hauled to base sanitary landfill	400,000	9,000

(1) Well costs and security costs are same for all alternatives.
(2) All contract disposal assumed at Kettleman Hills Site approximately 215 miles from Edwards AFB.

3.3.11 Environmental Monitoring

Each alternative has both short-term (during Phase IV remedial action construction) and long-term (post-closure) monitoring requirements. Alternative 5-1, no action/monitoring involves short-term monitoring and quarterly sampling of eight wells. Alternative 5-2 will involve OVA monitoring during tank cleaning and initial excavation to expose the tank tops and quarterly sampling and analysis of eight wells. Alternative 5-3 will include the same monitoring as Alternative 5-2 except that some maintenance of the cap will be required. Alternative 5-4 will involve OVA monitoring during tank and soil excavation and removal, and annual sampling of the eight wells.

3.4 SUMMARY OF PREFERRED ALTERNATIVES ANALYSIS

Based on the evaluation of preferred alternatives presented in this section, the following are the recommended remedial actions for Sites 1, 2, and 5.

3.4.1 Site 1 - North Lake Bed Disposal and Storage Site

The recommended alternative is 1-2. This consists of removing debris, drums with liquid and associated soil from the surface of Subsites 1A, 1B, 1D, and 1E and hauling the material to a secure Class I contract disposal site. All subsites will be graded to natural contours with local soil, and Subsites 1C and 1D will be covered with a synthetic liner and playa clay cap. Four wells will be installed to monitor ground water around Subsites 1A and 1E, and five wells for the same purpose around Subsites 1B, 1C, and 1D.

Alternative 1-2 was recommended because the source of contamination is effectively removed at Subsites 1A, 1B, 1D and 1E. The NO_3 contamination in the soil column is immobilized by placement of the cap and drainage control at the nitric acid pits. The likelihood that percolating water from the surface will leach nitrates into the ground water at a 135-foot depth is remote. Only when infiltration exceeds potential evaporation, and soil moisture exceeds field capacity will significant percolation occur. Neither situation will occur at Site 1. For example, assuming a maximum monthly rain event of 5.5 inches and a

potential evapotranspiration of 9 inches per month, infiltration cannot exceed evapotranspiration. In addition only 7 percent of the field capacity will be occupied with soil moisture in the 135-foot soil column at Site 1 even if one conservatively assumes no evapotranspiration (impossible), a maximum yearly rainfall of 14 inches (1984), and a 12 percent field capacity (effective porosity).

3.4.2 Site 2 - Main Base Waste Disposal Site

The recommended alternative is 2-1. This consists of the preparation of an up-gradient swale to divert rainfall run on, and the installation of three additional lysimeters to monitor the presence and quality of seasonal ground water.

This alternative was recommended due to the remote location of the site with respect to ground water and the low concentrations of contaminants at Site 2. If one assumed a 2-inch maximum monthly rainfall event at Site 2, no evapotranspiration (which is impossible), an effective porosity of 0.12, permeability of 1×10^{-4} cm/sec and a bedrock slope of 2 percent, it would take 213 years for seasonal water percolation from the site to reach the shores of Rogers Dry Lake (which is then two miles from the nearest production well). If a normal monthly evaporation of 9 inches is assumed, it is unlikely that significant seasonal ground water will even be generated. In fact during the past year since its installation, no water has been detected at the lysimeter located down gradient of Site 2.

3.4.3 Site 5 - South Base Underground Waste POL Storage Tanks

The recommended alternative is 5-2. This consists of proper disposal of the tank contents, cleaning the tanks, and filling them in-place with clean sand. Excavations will be backfilled and four new monitoring wells installed in the deep aquifer. This alternative is recommended because the source of any contamination is satisfactorily removed.

SECTION 4

RECOMMENDED REMEDIAL ACTION FOR EACH SITE

4.0 INTRODUCTION

This section presents the selected remedial actions for Sites 1, 2 and 5 at Edwards AFB. These actions will be implemented in Phase IV-B. These selections are based on the preliminary and detailed screening processes described in Sections 2 and 3, respectively. Each remedial action includes installation of a monitoring well system, controlling surface water run on and run off, and long-term maintenance of site facilities as described in Section 3. In addition, the recommended remedial actions for Sites 3, 4, 8, 13, and the Hazardous Waste Storage Yard are presented herein.

4.1 SITE 1 - NORTH LAKE BED DISPOSAL AND STORAGE SITE

The selected remedial action at Site 1 is Alternative 1-2. This involves the following actions at the subsites.

4.1.1 Subsite 1A - Motor Oil Disposal Trench

- Excavate remaining debris and associated surface soils and haul to either a secure Class I contract disposal site or the Main Base sanitary landfill depending on soil sampling and analysis results. Edwards AFB has approval to dispose of small quantities of oil and/or fuel contaminated soil in the Main Base sanitary landfill.
- Backfill the depression and grade to natural contours

4.1.2 Subsite 1B - Drum Storage

- Sample drums containing liquids and conduct compatibility testing for liquid waste bulking and shipping proposes

* Haul liquids to a secure Class I contract disposal site
* Steam clean empty drums, crush and dispose of drums at the Main Base sanitary landfill
* Haul drum residuals to a secure Class I contract disposal site

4.1.3 Subsite 1C - Nitric Acid Pits

* Place cap over all three individual pits
* Install fence at Subsites 1C and 1D

4.1.4 Subsite 1D - Drum Trenches

* Sample drums containing liquid
* Haul drums with liquid to a secure Class I contract disposal site
* Steam clean empty drums, crush and dispose of at the Main Base sanitary landfill
* Excavate associated surface debris and haul to a secure Class I contract disposal site or to Main Base landfill
* Backfill trenches with local soil and grade to natural contours
* Place cap over both trenches

4.1.5 Subsite 1E - Debris Dump

* Remove debris and surface soil and haul to the Main Base sanitary landfill
* Grade to natural contours

This option offers the best level of cleanup and contaminant immobilization at a reasonable cost. The majority of contaminant sources are removed and the most serious of the contaminants in the soil, the nitrates, will be immobilized by capping. Implementation of this remedial action will necessitate effective land use restrictions to ensure that no future excavation or construction takes place in the area.

4.2 SITE 2 - MAIN BASE WASTE DISPOSAL SITE

The recommended remedial action at this site is alternative 2-1, monitoring/site maintenance. The following factors favor this alternative:

- No ground water has been detected at the site
- The nearest aquifer is approximately 3,500 feet away laterally, and the nearest production well is three miles away
- Extensive soil boring results show low concentrations of chromium (6-82 mg/kg), lead (1-41 mg/kg), nitrate (1-93 mg/kg), and cyanide (<0.1 mg/kg) in the soil at the site
- Soils in the area have generally low permeabilities ranging from 10^{-4} to 10^{-7} cm/sec
- Rainfall is extremely low and evaporation extremely high, averaging 4 inches per year and 114 inches per year, respectively.

The recommended action will involve:

- Construction of up-gradient swale to divert rainfall run on
- Removal of surface debris and disposal in the Main Base sanitary landfill
- Filling of open trenches with local soil
- Installation of one up-gradient and two additional down-gradient lysimeters

4.3 SITE 5 - SOUTH BASE UNDERGROUND WASTE POL STORAGE TANKS

The recommended alternative for Site 5 is 5-2. This includes salvaging tank contents, excavating to expose the top of the tanks, cleaning of the tank interiors, filling of the tanks with local sand (i.e., burying in situ), and backfilling the excavations.

This option offers several advantages:

- The source of contamination (the tank contents) is removed
- Costs are reasonable as the tanks are disposed on the base and no cap is required

There is evidence of contamination of soils with oil at a 45-foot depth at Site 5. There is also evidence of contamination of the shallow aquifer with leaded fuels about one-half mile north of the site. As previously discussed, this contamination must come from another source as it is a different type of fuel than that stored at Site 5. However, both of these occurrences illustrate the need for further R&D work on in

situ treatment of soils contaminated with fuel or oil. The need for research in this area has been discussed with AFESC, Tyndall AFB.

4.4 OTHER SITES (3, 4, 8, and 13)

Based on the recommendations of the Phase II document and newly adopted TSD and Solid Waste Standards by the State of California, the selected recommendations at Sites 3, 4, 8, and 13 are described below:

4.4.1 Site 3 - Abandoned Sanitary Landfill

- Install one up-gradient and three down-gradient lysimeters

4.4.2 Site 4 - Main Base Sanitary Landfill

- Install one up-gradient and five down-gradient lysimeters

4.4.3 Site 8 - Industrial Waste Pond

- Install one up-gradient and three down-gradient monitoring wells

4.4.4 Site 13 - Air Force Rocket Propulsion Laboratory Sanitary Landfill

- Install one up-gradient and two down-gradient lysimeters

SECTION 5

CONCEPTUAL DOCUMENTS FOR REMEDIAL ACTION AT SITES 1, 2 AND 5

5.0 INTRODUCTION

This section includes the conceptual design and cost estimates for the selected remedial actions at Sites 1, 2 and 5. The information presented is of sufficient detail to be the base line document for the design and construction of the preferred remedial actions. Included herein are:

- Description of recommended remedial action at each site
- List of specifications
- List of drawings
- Implementation schedule
- Maintenance and monitoring requirements
  - Monitoring wells
  - General maintenance
- Additional design engineering data requirements
- Preliminary cost estimate

5.1 DESCRIPTION OF REMEDIAL ACTIONS

5.1.1 <u>Subsites 1A and 1E - Motor Oil Drum Disposal Trench</u>

Remaining debris in the sites such as, but not limited to, steel drums, filters and miscellaneous steel will be excavated, cleaned, and hauled to the Main Base sanitary landfill. Associated surface soil exposed by other cleanup actions at Subsite 1A will be excavated and hauled to a secure Class I contract disposal site. The asphalt in the spur road adjacent to Subsite 1A (as shown on Sheet No. 6) will be removed. Wooden posts and wire to the south of Subsite 1A will be

removed and hauled to the active Main Base sanitary landfill. Each site will then be regraded by backfilling with native soil. In the case of Subsite 1A, the sand mound located just to the south of the principal depression will be cut and used first. If additional fill material is required, it will be obtained from the designated borrow area located to the southwest of the site. In the case of Subsite 1E, fill material will be obtained from the designated borrow area located to the southeast. The borrow area will be cleared and grubbed to eliminate organic materials prior to use as fill. Each site will be graded to the contours shown on the plan and sections (Drawing No. AF 890-15-01, Sheet No. 6). After completion of the fill work at each site, each borrow area will be graded to provide drainage as required and will be left with side slopes no steeper than one vertical to four horizontal.

5.1.2 Subsite 1B - Drum Storage

Drum contents will be sampled and compatible materials combined and disposed of in a Class I disposal site. Rinsate will be collected in a portable pool for evaporation. Residue will be hauled to a Class I disposal site. All noncompatible samples will be disposed of in a Class I site also. Empty drums and associated pallets will be steam cleaned and disposed of in the Main Base sanitary landfill. The site will then be graded to minimize the appearance of a depression remaining in the playa area. Side slopes will not exceed one vertical to eight horizontal. As this site is in a playa area and because there is no apparent drainage from the site, the site may contain ponded water after rain.

5.1.3 Subsite 1C - Nitric Acid Pits

Without disturbing the existing surface of the three pits, except for the removal of brush or other debris which may penetrate the capping system, each of the pits will be covered with a 6-inch layer of native sandlike material which will act as a cushion for a synthetic liner. This sandlike material will be obtained from the designated borrow area located to the south of the sites. The borrow pit will be cleared and grubbed to eliminate organic material. Each pit will be covered with an individual synthetic liner which will be anchored in a 2-foot perimeter trench which will be filled with the sandlike material. Each site will

be covered with its own liner which will be of one-piece construction without field splices. A 2-foot playa clay cap will be placed over the liner and compacted to 90 percent of optimum density. The top of the cap will be sloped to drain, and the edges will be sloped as shown on the drawings (AF 890-15-01, Sheet Nos. 7 and 9) until they intersect the existing contours. Playa clay will be obtained from the designated borrow area located to the east of the site. The playa clay will be covered with 3 inches of uniformly graded crushed gravel. The maximum gravel particle size will not exceed 1-1/4 inches. In some cases, as shown on the drawings, the playa clay and crushed stone will extend to cover more than one of the subsites. After completion of the fill work at each pit, each borrow area for playa and sandlike materials will be graded to provide drainage as required. Remaining side slopes will be no steeper than one vertical to four horizontal. A 6-foot security fence will be installed around Subsites 1C and 1D.

5.1.4 Subsite 1D - Drum Trenches

All empty drums located at Subsite 1D will be steam cleaned on site. Rinsate will be collected in a portable pool for evaporation. The cleaned drums will be disposed of in the Main Base sanitary landfill. Residue will be hauled to a Class I disposal site. Compatible drum contents will be combined and disposed of in a Class I disposal site.

After the drums and debris have been removed, soil samples will be taken for analysis (five per trench). The trenches will then be filled with sandlike material from the borrow pit located to the south of the site to match the surrounding contours. The sand will be placed in 12-inch lifts (maximum) and will be compacted with a vibratory compactor. When the depressions have been filled, a cap will be installed. Each trench will be covered with an individual synthetic liner of one-piece construction without field splices. This liner will be anchored in a 2-foot perimeter trench filled with the sandlike material. A 2-foot playa clay cap will be placed over the liner and compacted to 90 percent of optimum density. The top of the cap will be sloped to drain, and the edges will be sloped as shown on the drawings (AF 890-15-01, Sheet Nos. 7 and 9) until they intersect the existing contours.

Playa clay will be obtained from the designated borrow area located to the east of the site. The playa clay will be covered with 3 inches of uniformly graded crushed gravel. The maximum gravel particle size will not exceed 1-1/4 inches. In some cases, as shown on the drawings, the clay and crushed stone will extend to cover more than one of the subsites. After completion of the fill work at each pit, each borrow area for playa and sandlike materials will be graded to provide drainage as required. Remaining side slopes will be no steeper than one vertical to four horizontal. A 6-foot security fence will be installed around Subsites 1C and 1D.

5.1.5 Site 2 - Main Base Waste Disposal Site

Site 2 will be regraded so as to fill in the depressions and level out the mounds as shown on the drawing (AF 890-15-01, Sheet No. 8). The existing fence will be removed. The uphill side of the site will also be graded to install a run-on control swale. This swale will divert rainfall around the site rather than through the site. Earthwork will be so designed to utilize only existing site soil so that no material will be trucked off site.

5.1.6 Site 5 - South Base Underground Waste POL Storage Tanks

The contents of all the 50,000-gallon storage tanks will be pumped out by the Contractor. Water in the tanks will be transported to the industrial waste pond. Fuel/water mixtures will be transported to the new POL storage facility. All five tanks will then be cleaned in place, including dismantling pumps and associated piping. Residue and spent cleaning fluids will be collected, solidified if necessary, and disposed of in a secure Class I contract disposal site. Soil covering the tanks will be removed, two or three large holes cut in the tank tops, and local clean sand poured in to fill the tanks. The excavations will then be backfilled and graded to natural contours. Backfill material obtained from the borrow area will be compacted to 90 percent of optimum density using 12-inch maximum lifts. The cleanup work on this site will not begin until the new POL storage facility is in operation. It is estimated that this new facility will be operational January 15, 1985.

5.2 LIST OF SPECIFICATIONS

A list of specifications to be prepared for each site is presented in Table 5.1.

5.3 LIST OF DRAWINGS

A list of drawings to be prepared for each site is presented in Table 5.2. The actual drawings are presented at the end of this section.

5.4 IMPLEMENTATION SCHEDULE

A preliminary project schedule for the construction phase of the recommended remedial actions for Sites 1, 2 and 5 is shown in Figure 5.1. This schedule has been developed to optimize construction crew size and utilization of construction equipment so that the remedial activities at each site can be completed most economically.

5.5 MONITORING AND MAINTENANCE REQUIREMENTS

A remedial action operation and maintenance manual is presented in Appendix F.

5.5.1 Monitoring Requirements

5.5.1.1 Site 1

A total of nine monitoring wells will be installed at the subsites of Site 1. At Subsites 1A and 1E, one up-gradient and three down-gradient 4-inch diameter monitoring wells will be installed to a 200-foot depth at the locations shown on the drawing (No. AF 890-15-01, Sheet No. 6). One up-gradient and four down-gradient, 4-inch diameter monitoring wells will be installed around Subsites 1B, 1C, and 1D at the locations shown on Drawing No. AF 890-15-01, Sheet No. 7. Each well will be installed to a depth of 200 feet.

Post-closure monitoring at these wells will be conducted during the first two years on a quarterly basis. Each well will be properly developed prior to sampling (i.e., four well volumes will be removed prior to well sampling). Samples will be collected using a Teflon

TABLE 5.1

LIST OF SPECIFICATIONS

Section Number	Specification Title
Division 1 - General Requirements	
1A	Special Clauses
1B	Warranty of Construction
1C	Environment Protection
1D	Summary of Work
1E	Measurement and Payment
1F	Pre-Construction and Pre-Work Conference
1G	Progress Meetings and Reports
1H	Project Schedules
1I	Project Photographs
1J	Safety, Health and Emergency Response Requirements
1K	Site Specific Quality Management Plan (SSQMP)
1L	Temporary Utilities and Control
1M	Spill Control
1N	Dust Control
1O	Security
1P	Field Offices and Sheds
1Q	Project Record Documents
1R	Definitions
1S	Special Project Procedures
1T	Air Monitoring
1U	Submittals
Division 2 - Site Work	
2A	Site Preparation
2B	(Reserved)
2C	Survey Data
2D	In Situ Tank Deactivation
2E	Contaminated Surface Soil Removal
2F	Contaminated Liquids Removal and Drum Cleaning
2G	Off-Site Transportation
2H	Off-Site Disposal
2I	Final Grading and Placement of System
2J	Chain Link Security Fence
2K	Lysimeter Installation
2L	Monitoring Well Installation
2M	Site Maintenance
2N	Demobilization

TABLE 5.2

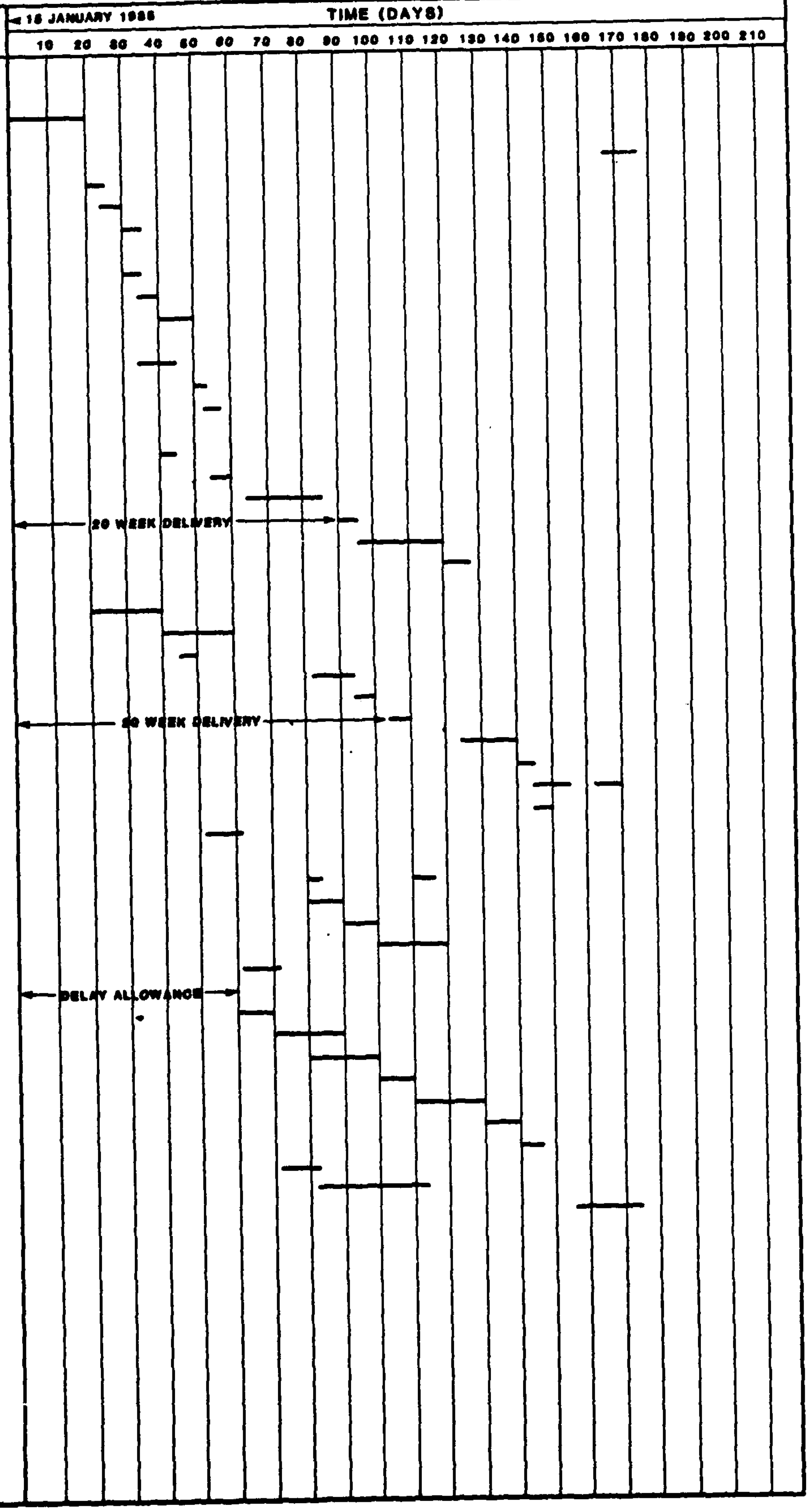
LIST OF DRAWINGS

Drawing Number	Sheet No.	Title
AF 890-15-01	1	Site Location Plan and Index
AF 890-15-01	2	Subsites 1A and 1E Existing Site Contour
AF 890-15-01	3	Subsites 1B, 1C, and 1D Existing Site Contour
AF 890-15-01	4	Site 2 - Existing Site Contour
AF 890-15-01	5	Site 5 Plans and Sections
AF 890-15-01	6	Subsites 1A and 1E Proposed Site Contour and Cross-sections
AF 890-15-01	7	Subsites 1B, 1C, and 1D Proposed Site Contour
AF 890-15-01	8	Site 2 Proposed Site Contour
AF 890-15-01	9	Subsites 1B, 1C, and 1D Cross-sections
AF 890-15-01	10	Subsites 1B, 1C, and 1D - Location of Construction Trailer, Decontamination Facility and Contamination Reduction Zone

FIGURE 5.1

EDWARDS AFB
REMEDIAL ACTION CONSTRUCTION SCHEDULE

CONSTRUCTION ACTIVITIES	TOTAL TIME (DAYS)
GENERAL CONSIDERATIONS	
Mob	20
Demob	10
SITE 1A	
Survey	4
Debris	4
Grading	4
SITE 1E	
Debris	2
Grading	2
Wells1A/1BE	10
SITE 1B	
Drums	10
Soil	4
Grading	2
SITE 1C	
Survey	8
Grubbing	4
Sand	20
Liner	8
Playa Cover	24
Gravel	16
SITE 1D	
Drum Cleaning	20
Drum Removal	20
Survey	6
Sand Filling	10
Trenching	5
Liner	4
Playa	12
Gravel	6
Fence	20
Grading	4
Wells 1B,1C,1D	10
SITE 2	
Survey	8
Fence Removal	10
Grubbing	10
Grading	20
Wells	10
SITE 5	
Soil	10
Anc. Removal	20
Decon Tanks	20
Fill Tanks	14
Backfilling	20
Final Grading	10
Fence Repair	6
Wells	10
Other Wells	30
Final Survey	20



bailer. Samples will be analyzed for pH and specific conductivity in the field. The samples will then be preserved and shipped to a certified laboratory for analysis of volatile organic compounds, TOC and fuel oils (Subsites 1A/1E) and TOC, volatile organic compounds, and nitrates (Subsites 1B, 1C, 1D).

If contamination is not detected during the first two years following completion of the remedial actions at Site 1, then a reduced frequency of sampling and analysis will be implemented in succeeding years. The reduced schedule will be annual sampling from years 3 through 30. In addition, following two years of analysis, only those specific volatile organics which have been detected during the first two years will be analyzed thereafter.

If contamination is detected at any time, sampling will revert to a quarterly frequency.

5.5.1.2 Site 2

An additional three lysimeters will be installed at a depth of 20 feet at Site 2. Each lysimeter will be sampled quarterly following rain. The samples will be analyzed for total chromium, hexalent chromium, cyanide, tetraethyl lead, pH and specific conductivity. If water is not obtained in the lysimeters after five years of sampling, then the sampling and analysis will be discontinued. If water is obtained, but no contamination is detected, the frequency of sampling will be changed to an annual basis from years 3 to 30.

If contamination is detected at any time, sampling will revert to a quarterly frequency.

5.5.1.3 Site 5

Four additional monitoring wells will be installed to a 100-foot depth at Site 5. Post-closure monitoring of these wells will be conducted on a quarterly basis for the first two years. Each well will be developed by removing four well volumes with a PVC bailer. The well will then be sampled and analyzed for pH and specific conductivity in the field. Samples will be preserved and shipped to a certified laboratory for analysis of volatile organics, lead, and fuel oils.

If contamination is not detected during the first two years following completion of the remedial actions at Site 1, then a reduced frequency of sampling and analysis will be implemented in succeeding years. The reduced schedule will include annual sampling from years 3 through 30. In addition, following two years of analysis, only those specific organics which have been detected during the first two years will be analyzed thereafter.

If contamination is detected at any time, sampling will revert to a quarterly basis.

5.5.2 Maintenance Requirements

Every three months, each site will be visually inspected. The visual inspection will include an evaluation of:

- Conditions of the fence, gates and locks
- Presence of growth of rooted vegetation which is likely to penetrate the cap liners at Subsites 1C and 1D
- Wind or rain erosion which is sufficient to require correction
- Presence of animal burrowings which will require correction
- Vandalism or other actions which will require correction

It is estimated that the site life will be fifty years. It is estimated that the fence and marker signs will require painting every three years and replacement at twenty-year intervals. In addition, rooted vegetation will have to be removed annually and a cap will require minor repairs at approximately the same interval. If vegetation becomes a problem, the capped area should be sprayed with a biocide to prevent growth. It is suggested that if burrowing animals become a problem, a professional exterminator be employed to place chemicals in an environmentally safe manner at Subsites 1C and 1D to discourage animals from frequenting these areas.

5.6 ADDITIONAL DESIGN ENGINEERING DATA REQUIREMENTS

To complete the final remedial action design the following additional engineering data is required:

- Sampling and analysis of drums of liquid and solids at Subsites 1B and 1D prior to ultimate disposal of this material
- Geotechnical soils tests for samples of playa clay deposits to be used as cover material at Site 1, including permeability, dry density, optimum moisture content, and density curves for field determination of soil density

5.7 PRELIMINARY COST ESTIMATE

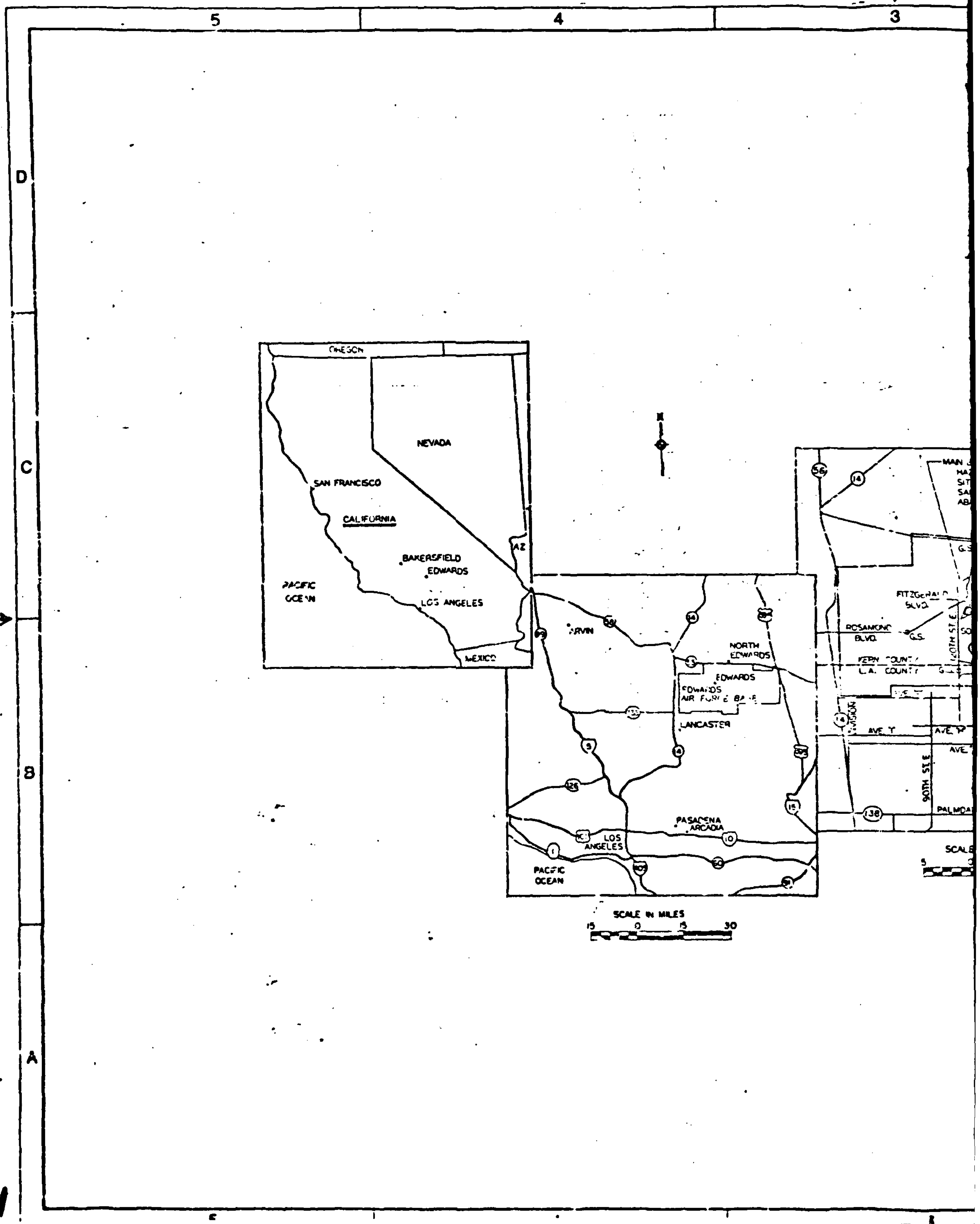
The preliminary cost estimate for the recommended remedial actions at Sites 1, 2 and 5 has been prepared. Table 5.3 is a summary of capital costs and O&M costs for each site. The costs presented are based on a life of fifty years.

TABLE 5.3

PRELIMINARY COST ESTIMATES FOR
RECOMMENDED REMEDIAL ACTIONS

Site No.	Subsites	Capital[1] Cost ($)	O&M Cost[2] ($/yr)
1	1A, 1B, 1C, 1D, 1E	440,000	17,000
2	2	30,000	2,000
5	5	200,000	7,400

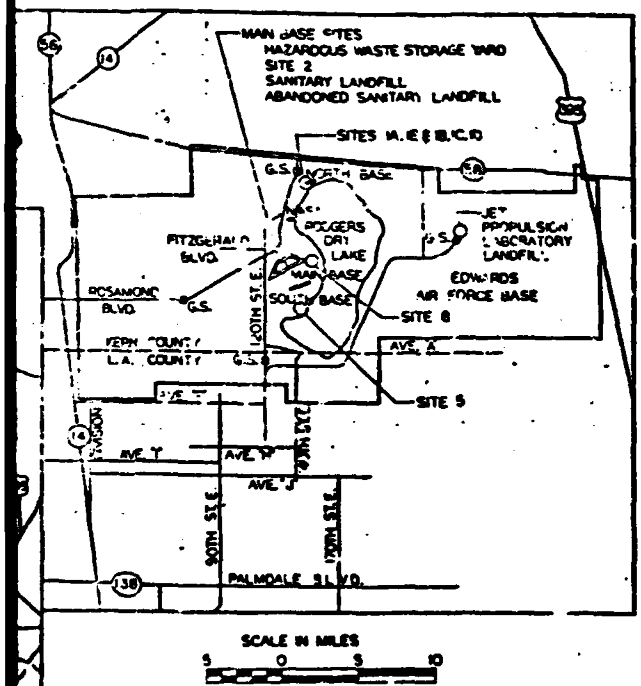
(1) Capital cost includes 25 percent contingency, 25 percent contractor overhead and profit, and 10 percent engineering.
(2) O&M costs based on 50-year life.


5
4
3
D
C
B
A
NEVADA
SAN FRANCISCO
CALIFORNIA
BAKERSFIELD
EDWARDS
PACIFIC OCEAN
LOS ANGELES
AZ
ARVIN
NORTH EDWARDS
EDWARDS
LANCASTER
PASADENA
ARCADIA
LOS ANGELES
PACIFIC OCEAN
SCALE IN MILES
15 0 15 30
ROSAMOND BLVD.
G.S.
90TH ST. E

3 | 2 | 1

INDEX

TITLE	SHEET NO.
SITE LOCATION PLAN & INDEX	1
SITE Nos. IA & IE - EXISTING SITE CONTOUR	2
SITE Nos. IB, IC & ID - EXISTING SITE CONTOUR	3
SITE No. 2 - EXISTING SITE CONTOUR	4
SITE No. 5 - PLAN & SECTIONS	5
SITE Nos. IA & IE - PROPOSED SITE CONTOUR AND CROSS SECTIONS	6
SITE Nos. IB, IC & ID - PROPOSED SITE CONTOUR	7
SITE No. 2 - PROPOSED SITE CONTOUR	8
SITE Nos. IB, IC & ID - SECTIONS	9
SITE Nos. IB, IC & ID - LOCATION OF CONSTRUCTION TRAILER, DECON. FACILITY & CONTAMINATION REDUCTION ZONE	10



$$ — THINK VALUE ENGINEERING — $$

Revision			
Symbol	Descriptions	Date	Approved

ENGINEERING-SCIENCE
ARCADIA, CALIFORNIA

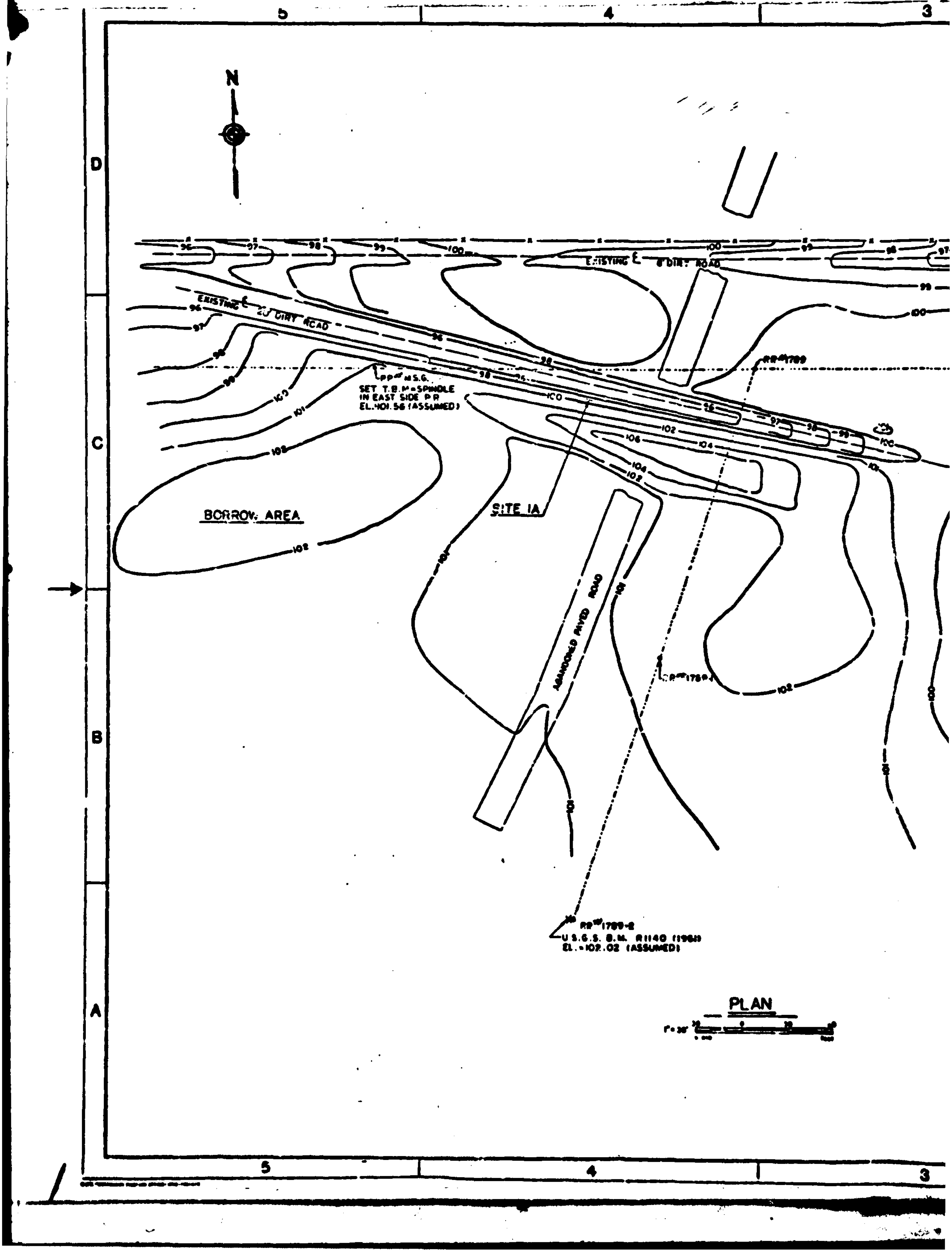
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

EDWARDS A.F.B. CALIFORNIA
HAZARDOUS WASTE CLEANUP
INSTALLATION RESTORATION PROGRAM (IRP)
PHASE II

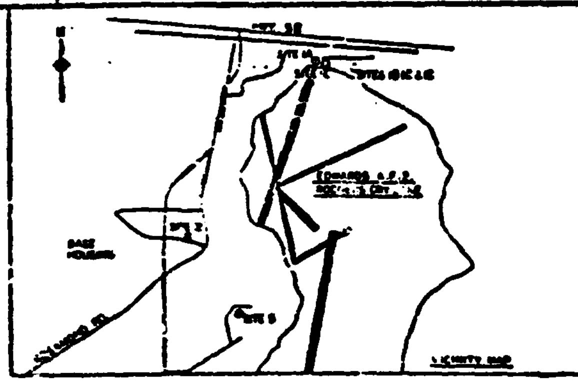
SITE LOCATION PLAN
& INDEX

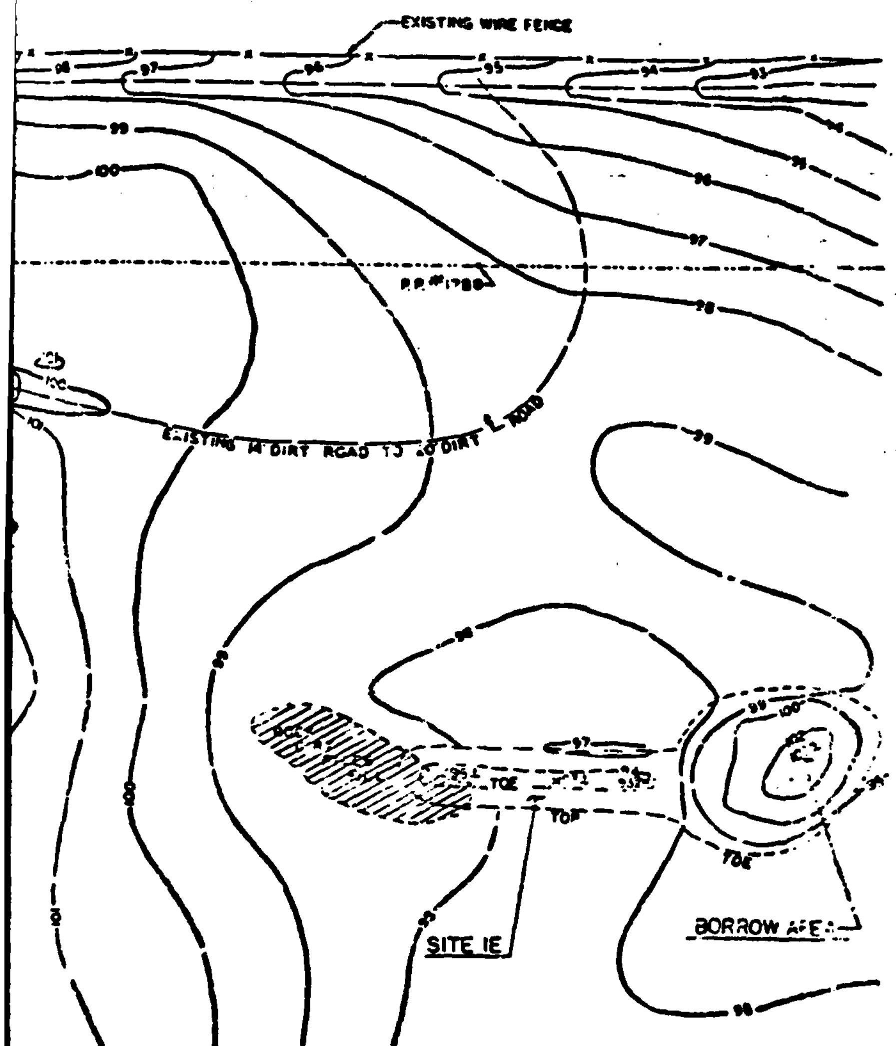
Designed by: R.S. CARLOS
Drawn by: S.P. STAWICKI
Checked by: R.S. CARLOS
Reviewed by: [signature]
Submitted by: [signature]

Scale: As Shown
Sheet reference number: 1
Date: 13, JULY '84
Drawing Code: AF890-15-01



5
4
3
D
C
B
A
N
EXISTING ℄ 8' DIRT ROAD
EXISTING ℄ 20' DIRT ROAD
SET T.B.M.=SPINDLE
IN EAST SIDE P.R.
EL. 101.56 (ASSUMED)
BORROW AREA
SITE IA
ABANDONED PAVED ROAD
U.S.G.S. B.M. R1140 (1961)
EL.=102.02 (ASSUMED)
PLAN

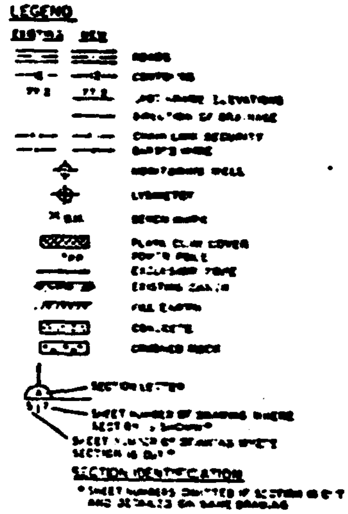




GENERAL NOTES

1. SURVEY INFORMATION PROVIDED BY SITE SURVEY, LANCASTER, CALIFORNIA 93534

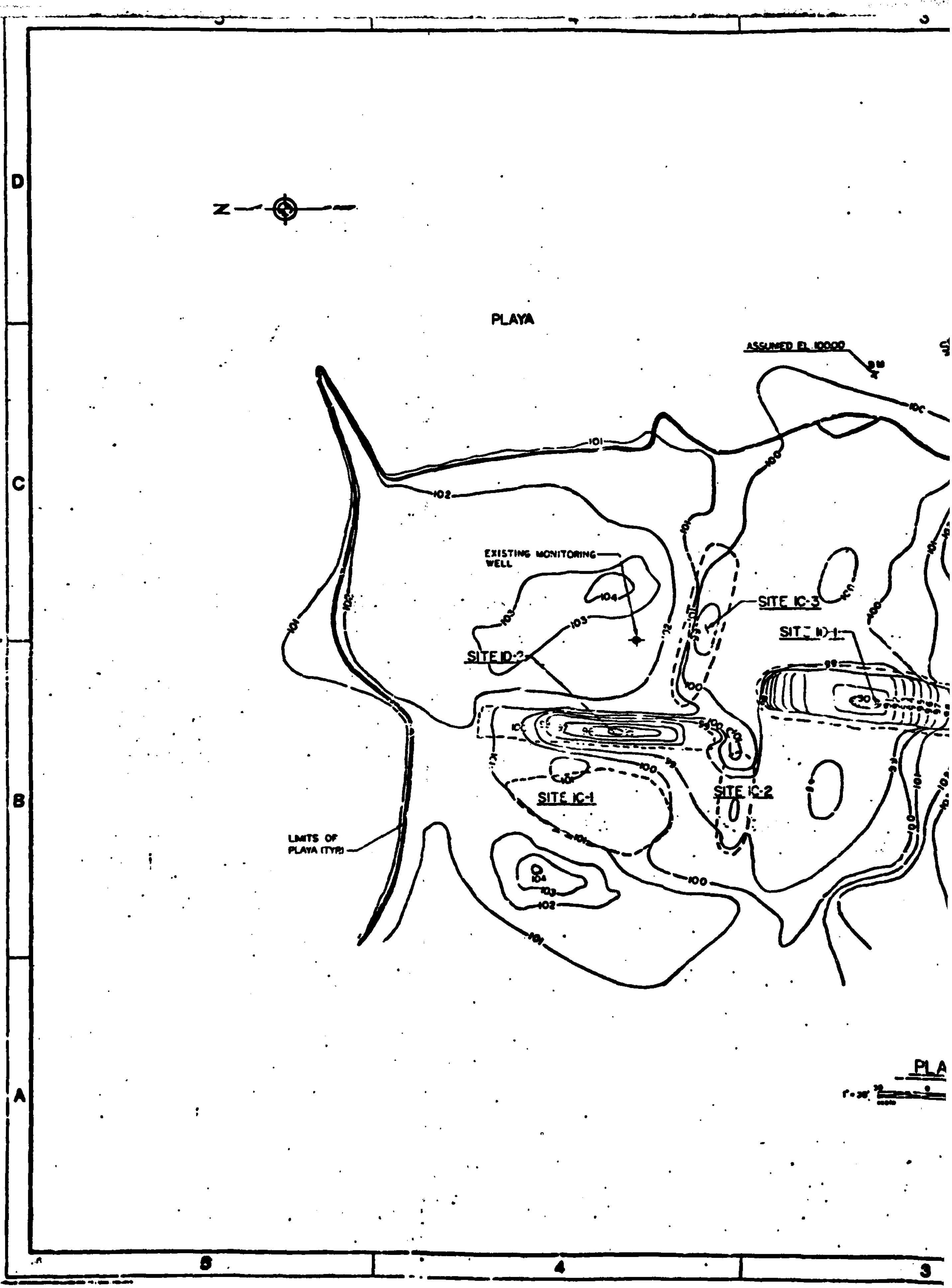
LEGEND

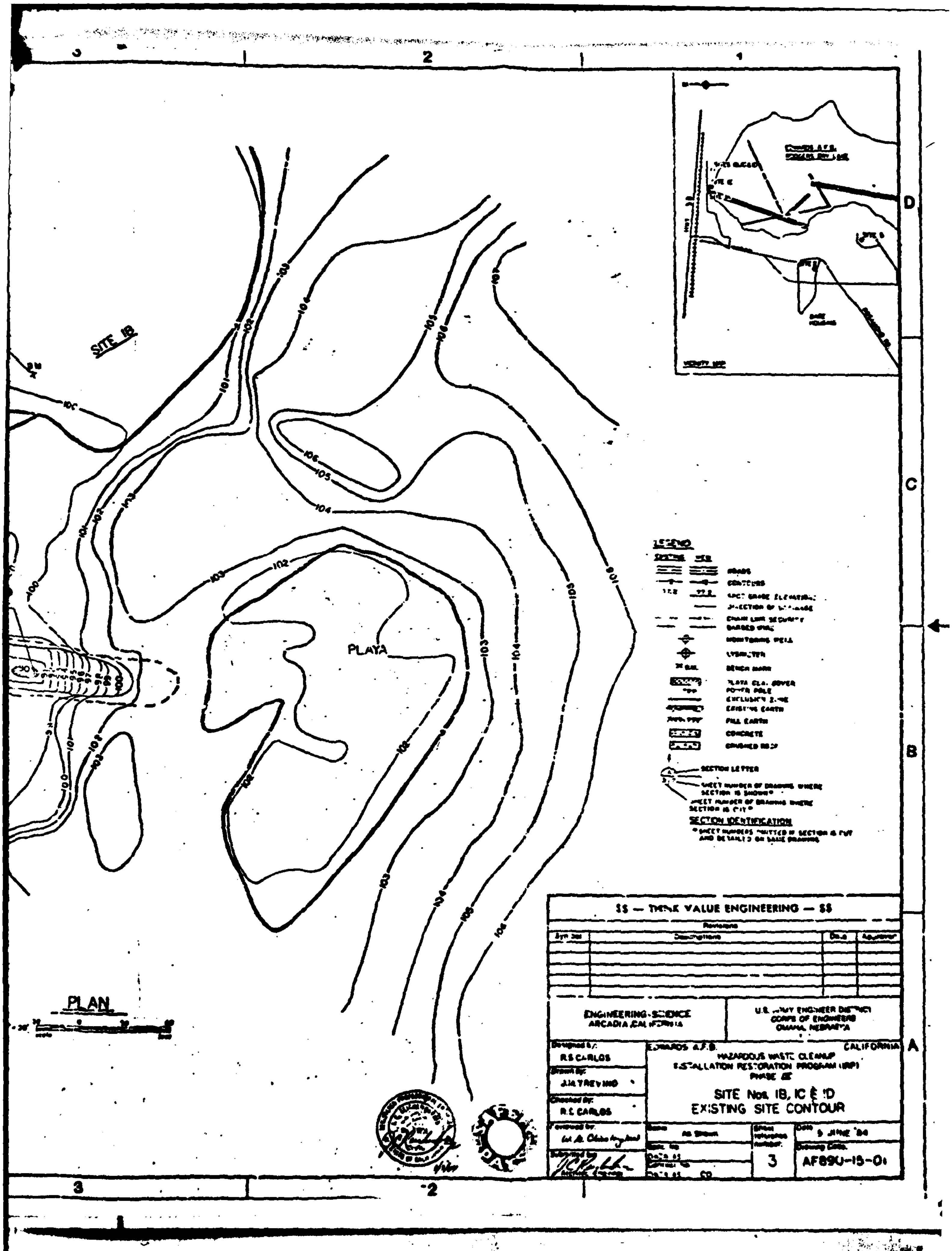


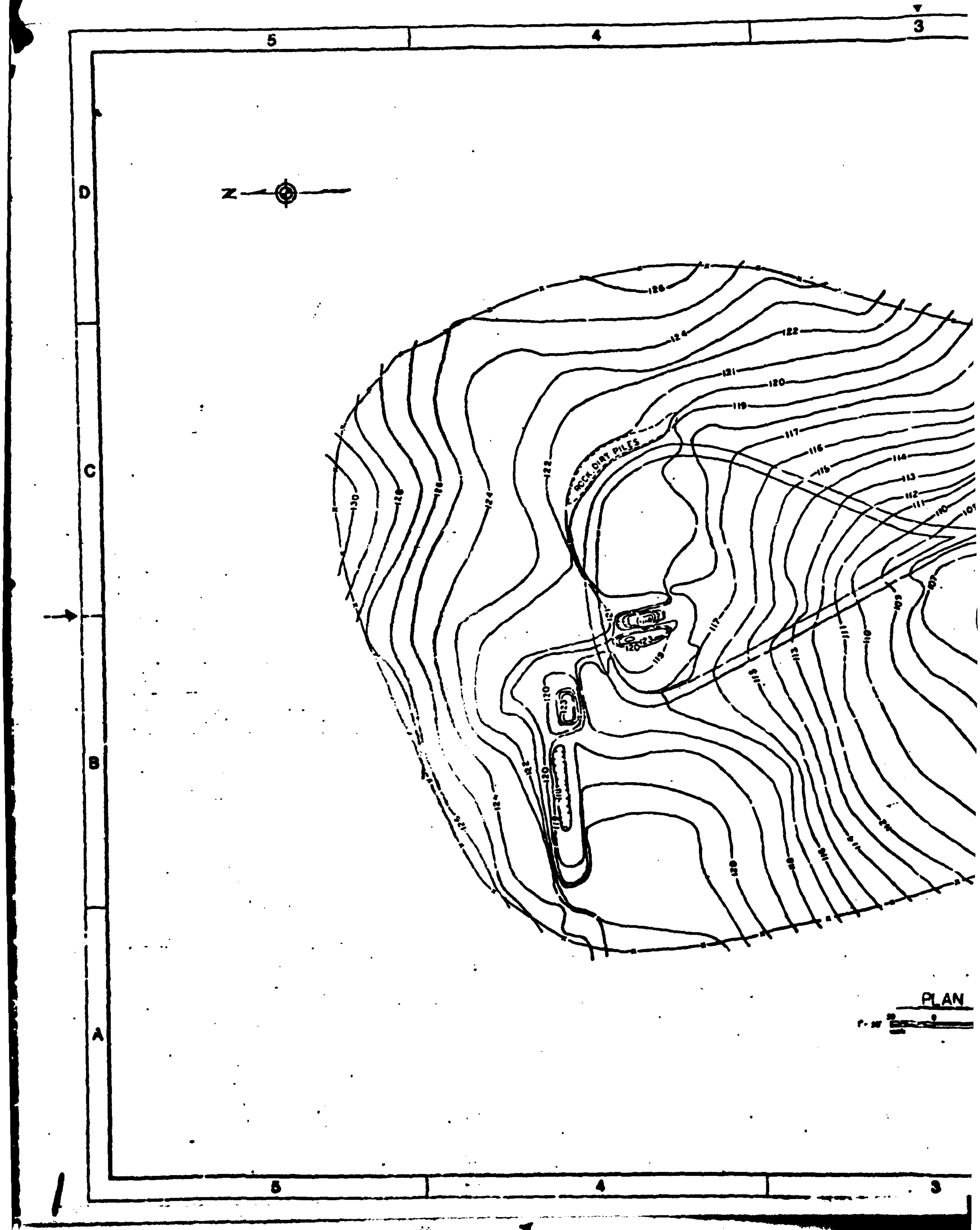
$$ — THINK VALUE ENGINEERING — $$			
Revisions			
Symbol	Descriptions	Date	Approved

ENGINEERING-SCIENCE ARCADIA, CALIFORNIA	U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS OMAHA, NEBRASKA

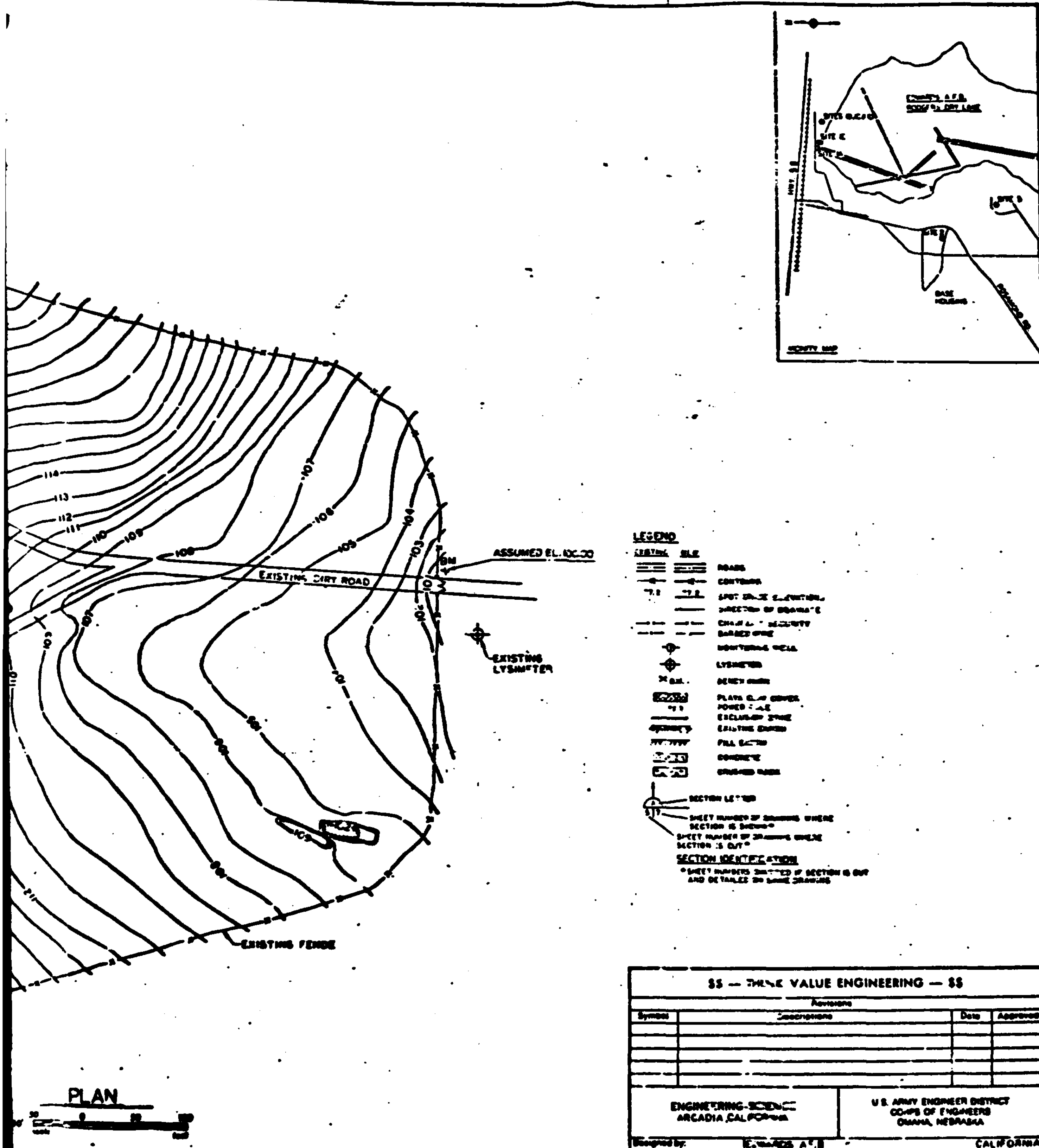
Designed by: R.S. CARLOS	EDWARDS A.F.B. CALIFORNIA HAZARDOUS WASTE CLEANUP INSTALLATION RESTORATION PROGRAM (IRP) PHASE II SITE Nos. IA & IE EXISTING SITE CONTOUR		
Drawn by: J.M. TREVINO			
Checked by: R.S. CARLOS			
Reviewed by:	Scale: As Shown	Sheet reference number: 2	Date: 5 JULY '84
Submitted by:			Drawing Code: AF890-15-01


D
C
B
A
5
4
3
PLAYA
ASSUMED EL 100.00
EXISTING MONITORING WELL
SITE IC-3
SITE ID-2
SITE IC-1
SITE IC-2
LIMITS OF PLAYA (TYP)


SITE IB
PLAYA
PLAN
LEGEND
SECTION IDENTIFICATION
$$ — THINK VALUE ENGINEERING — $$
Revisions
ENGINEERING-SCIENCE
ARCADIA CALIFORNIA
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA
Designed by: R.S CARLOS
Drawn by: J.M. TREVINO
Checked by: R.S CARLOS
EDWARDS A.F.B. CALIFORNIA
HAZARDOUS WASTE CLEANUP
INSTALLATION RESTORATION PROGRAM (IRP)
PHASE II
SITE Nos. IB, IC & ID
EXISTING SITE CONTOUR
3
AF89U-15-01



5
4
3
D
C
B
A
ROCK DIRT PILES
PLAN



$$ — THINK VALUE ENGINEERING — $$

Symbol	Descriptions	Date	Approved

ENGINEERING-SCIENCE
ARCADIA, CALIFORNIA

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

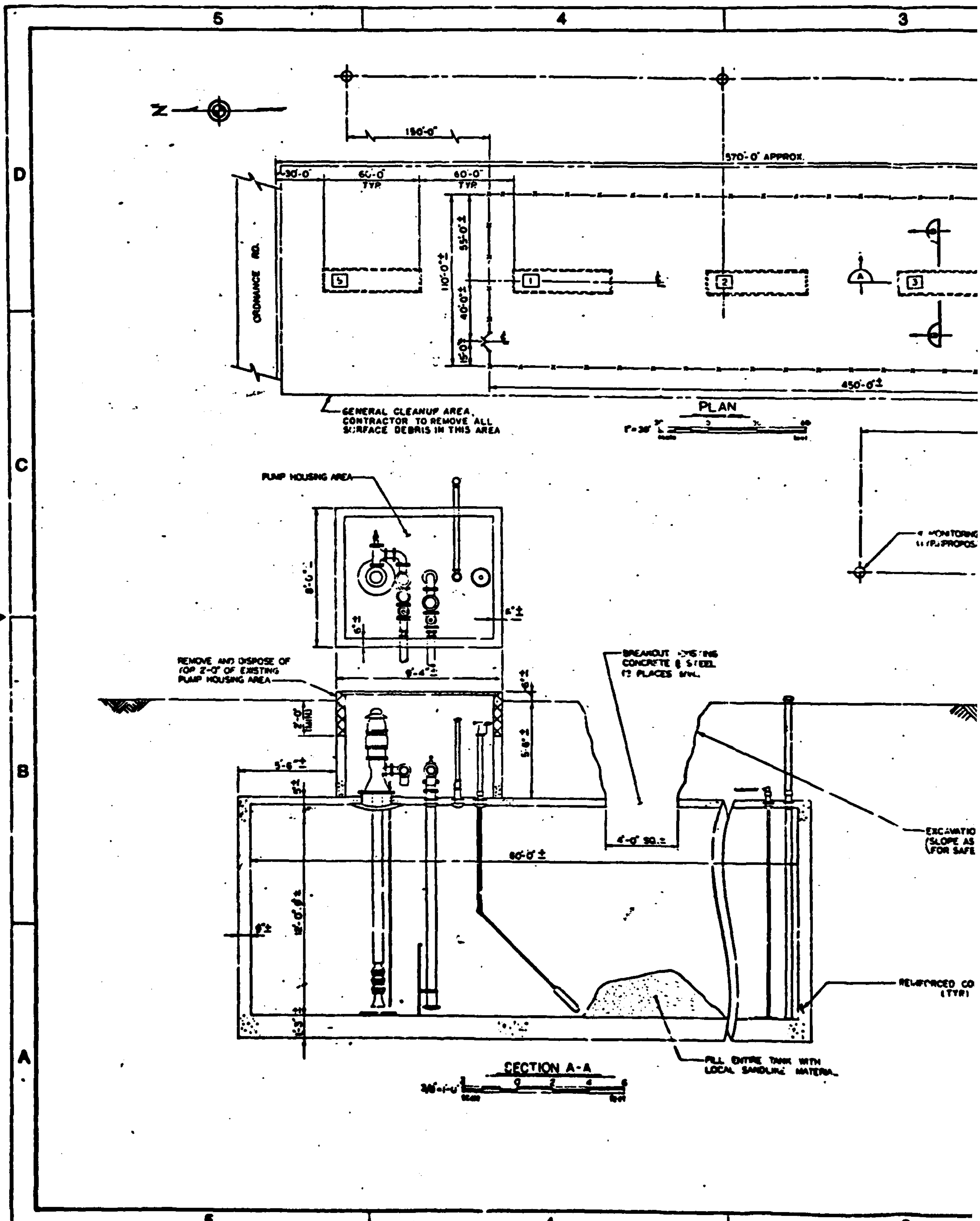
EDWARDS A.F.B. — CALIFORNIA

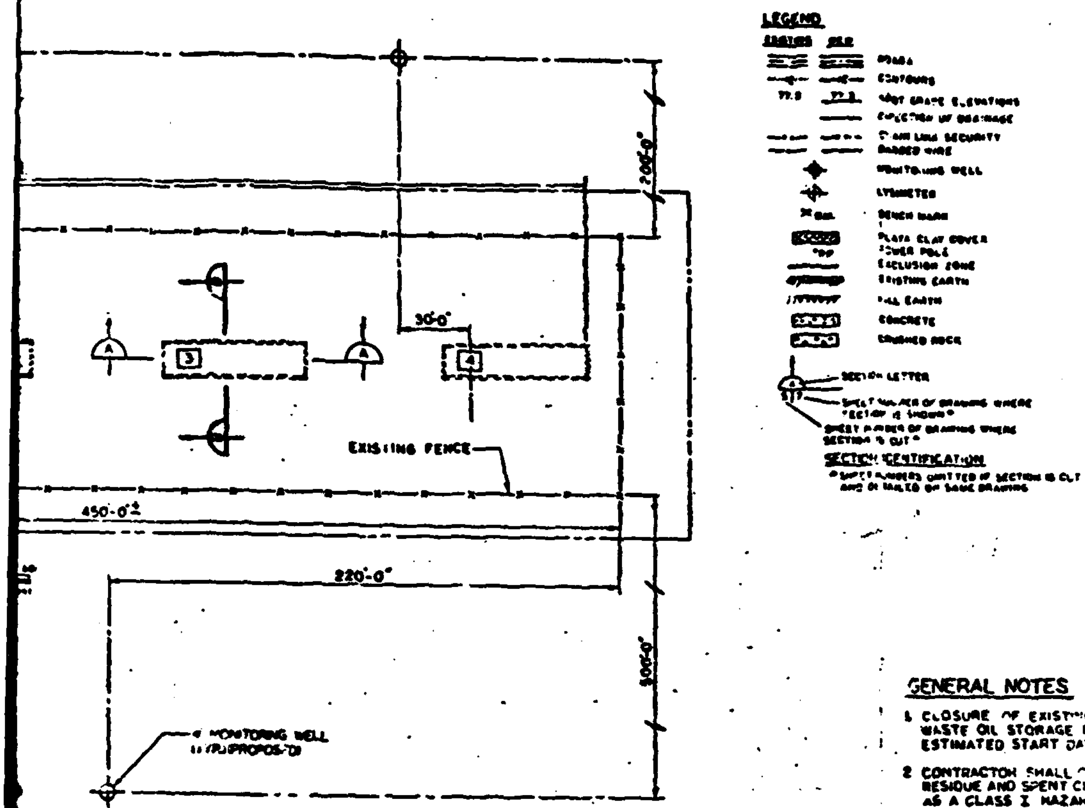
HAZARDOUS WASTE CLEANUP
INSTALLATION RESTORATION PROGRAM (IRP)
PHASE II

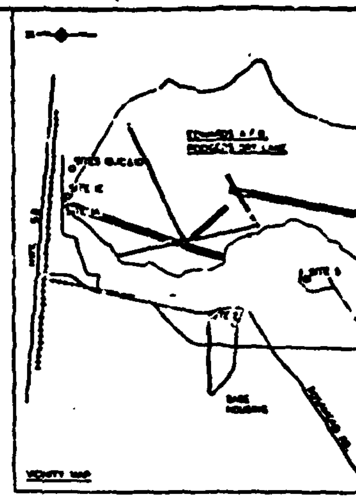
SITE No. 2
EXISTING SITE CONTOUR

Designed by: R.S. CARLOS
Drawn by: J.M. TREVINO
Checked by: R.S. CARLOS
Reviewed by: [signature]

Scale: As Shown
Sheet reference number: 4
Date: 5 JUNE '84
Drawing Code: AF890-15-01

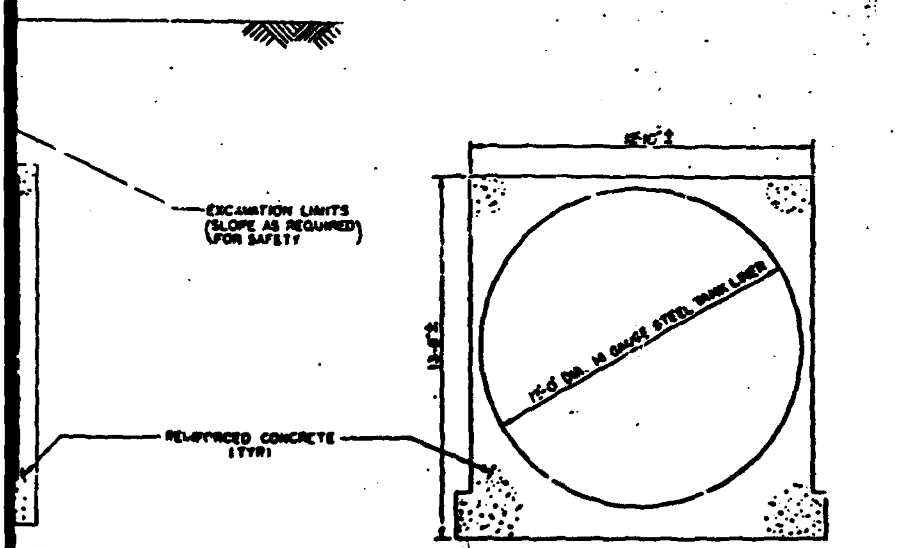

5
4
3
D
C
B
A
N
150'-0"
570'-0" APPROX.
30'-0"
60'-0" TYP.
60'-0" TYP.
ORDNANCE RD.
110'-0"±
55'-0"±
40'-0"±
15'-0"±
450'-0"±
GENERAL CLEANUP AREA, CONTRACTOR TO REMOVE ALL SURFACE DEBRIS IN THIS AREA
PLAN
PUMP HOUSING AREA
8'-0"±
9'-4"±
REMOVE AND DISPOSE OF TOP 2'-0" OF EXISTING PUMP HOUSING AREA
BREAKOUT EXISTING CONCRETE & STEEL
5'-6"±
4'-0" SQ.±
60'-0"±
12'-0"±
EXCAVATIO
(SLOPE AS
FOR SAFE
REINFORCED CO
(TYP)
FILL ENTIRE TANK WITH LOCAL SANDLIKE MATERIAL
SECTION A-A





GENERAL NOTES

1. CLOSURE OF EXISTING TANK SHALL NOT BEGIN UNTIL NEW WASTE OIL STORAGE FACILITY IS CONSTRUCTED AND OPERATIONAL. ESTIMATED START DATE FOR DEMOLITION IS NOVEMBER 15, 1984.
2. CONTRACTOR SHALL CLEAN INSIDE OF TANKS PRIOR TO CLOSURE. RESIDUE AND SPENT CLEANING MATERIALS SHALL BE DISPOSED OF AS A CLASS I HAZARDOUS WASTE.



SECTION B-B

$$ — THINK VALUE ENGINEERING — $$

Symbol	Descriptions	Date	Approved

ENGINEERING-SCIENCE
ARCADIA, CALIFORNIA

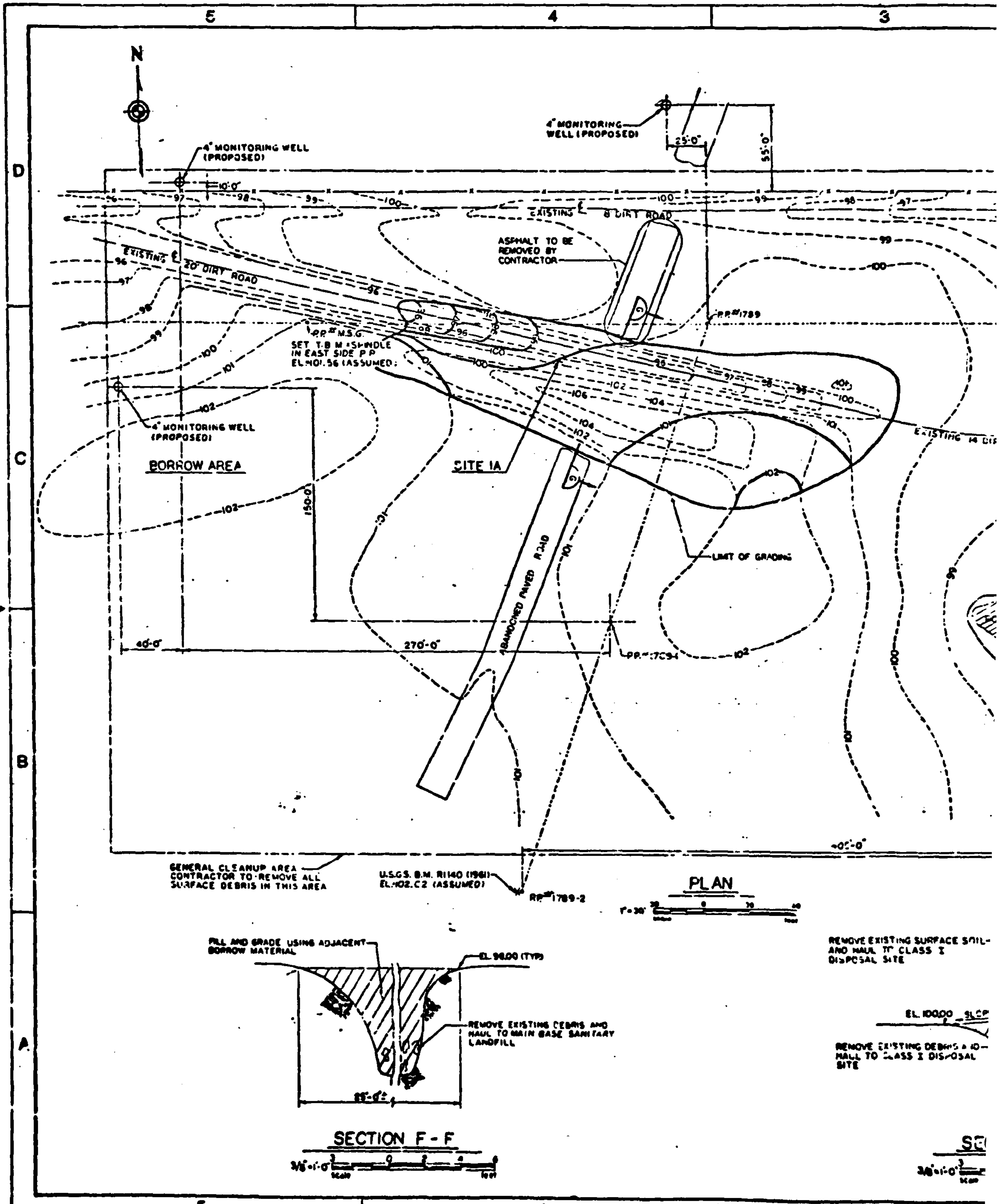
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

Designed by: R S CARLOS
Drawn by: J.M. TREVINO
Checked by: R S CARLOS

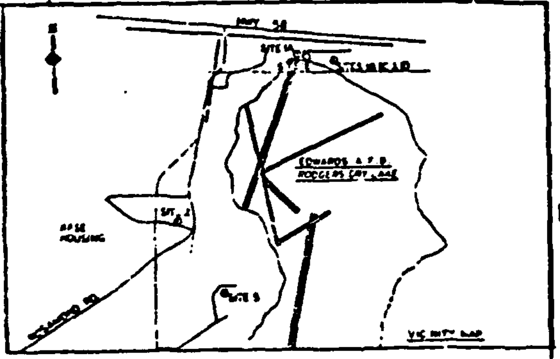
EDWARDS A.F.B. CALIFORNIA
HAZARDOUS WASTE CLEANUP
INSTALLATION RESTORATION PROGRAM (IRP)
PHASE II

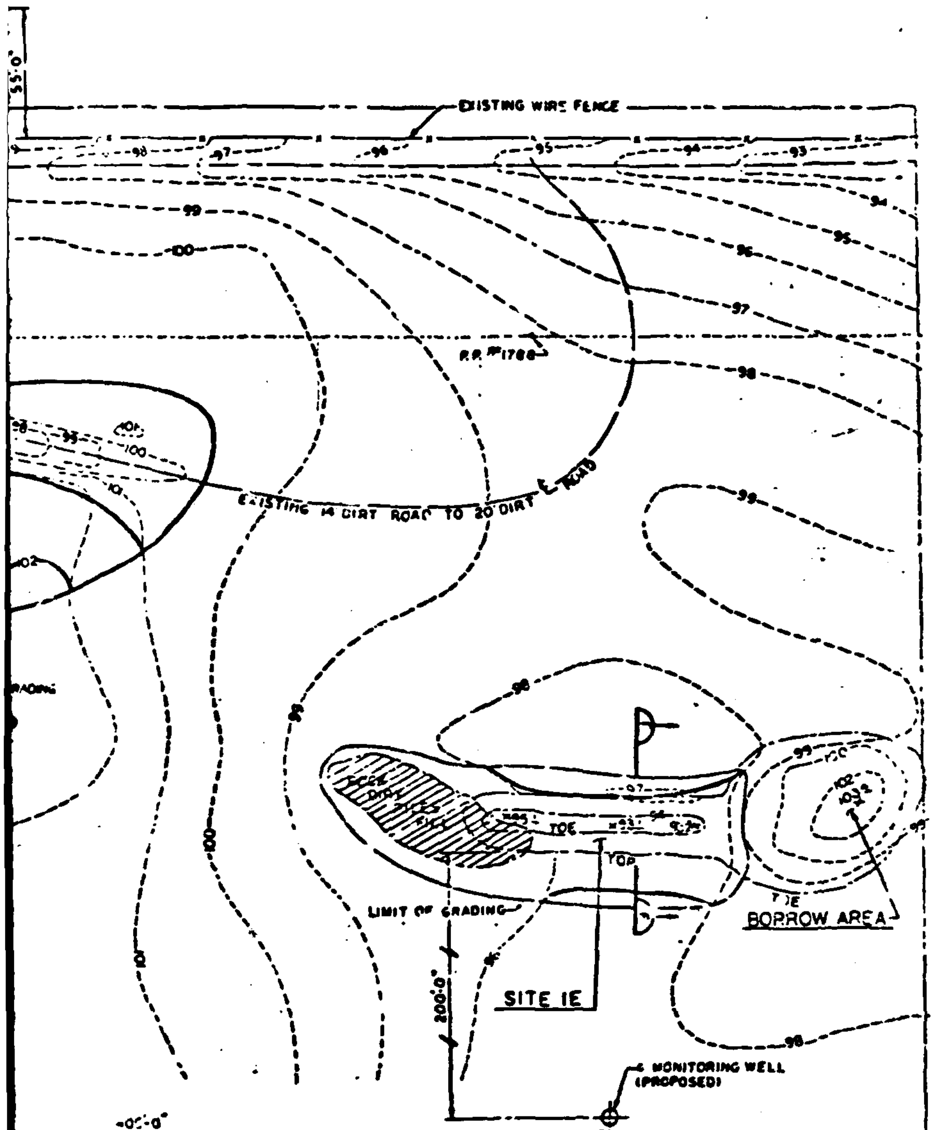
SITE No. 5
PLAN AND SECTIONS

Scale: As Shown
Sheet reference number: 5
Date: 5 JUNE '84
Drawing Code: AF890-15-01



4" MONITORING WELL (PROPOSED)
4" MONITORING WELL (PROPOSED)
4" MONITORING WELL (PROPOSED)
EXISTING ℄ 8' DIRT ROAD
EXISTING ℄ 20' DIRT ROAD
ASPHALT TO BE REMOVED BY CONTRACTOR
SET T.B.M. +SPINDLE IN EAST SIDE P.P. EL.101.56 (ASSUMED)
BORROW AREA
SITE 1A
LIMIT OF GRADING
ABANDONED PAVED ROAD
EXISTING 14' DIRT
GENERAL CLEANUP AREA CONTRACTOR TO REMOVE ALL SURFACE DEBRIS IN THIS AREA
U.S.G.S. B.M. R1140 (1961) EL.102.C2 (ASSUMED)
PLAN
FILL AND GRADE USING ADJACENT BORROW MATERIAL
EL. 98.00 (TYP)
REMOVE EXISTING DEBRIS AND HAUL TO MAIN BASE SANITARY LANDFILL
SECTION F - F
REMOVE EXISTING SURFACE SOIL AND HAUL TO CLASS I DISPOSAL SITE
EL. 100.00





LEGEND

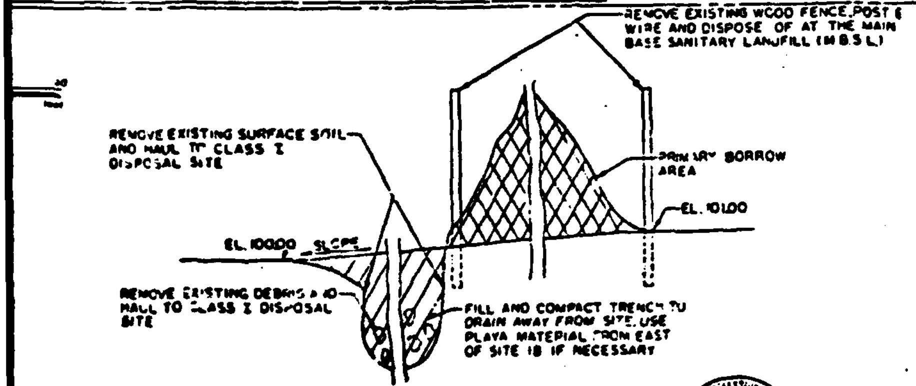
EXISTING | NEW

- ROADS
- CONTOURS
- SPOT GRADE ELEVATIONS
- DIRECTION OF DRAINAGE
- CHAIN LINK SECURITY BARBED WIRE
- MONITORING WELL
- LYSIMETER
- BENCH MARK
- PLAYA CLAY COVER
- POWER POLE
- EXCLUSION ZONE
- EXISTING EARTH
- FILL EARTH
- CONCRETE
- CRUSHED ROCK

SECTION LETTER
SHEET NUMBER OF DRAWING WHERE SECTION IS SHOWN*
SHEET NUMBER OF DRAWING WHERE SECTION IS CUT*

SECTION IDENTIFICATION

*SHEET NUMBERS OMITTED IF SECTION IS CUT AND DETAILED ON SAME DRAWING



SECTION G-G

3/8"=1'-0" SCALE 3 0 2 4 6 FEET

$$ — THINK VALUE ENGINEERING — $$

Revisions			
Symbol	Descriptions	Date	Approved

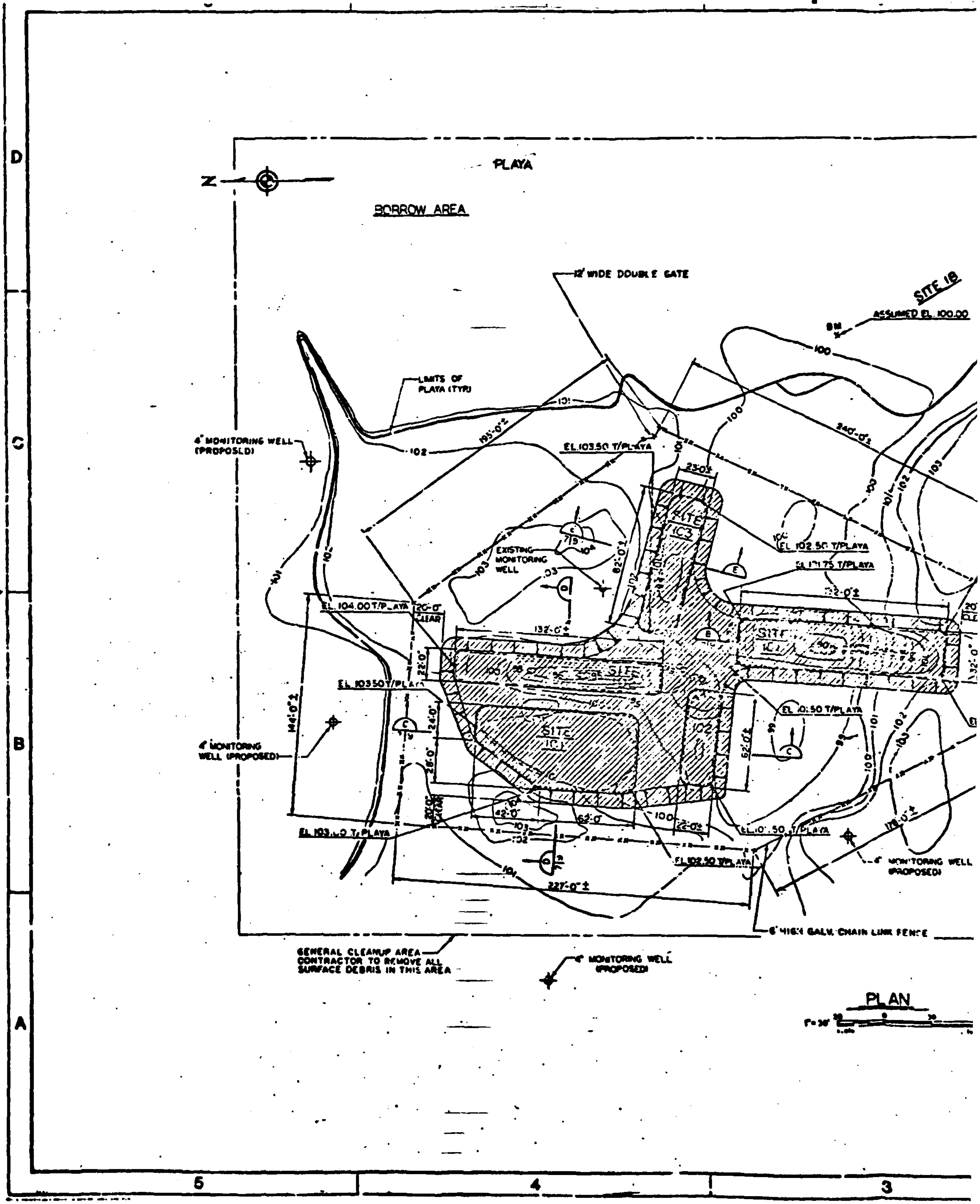
ENGINEERING-SCIENCE
ARCADIA, CALIFORNIA

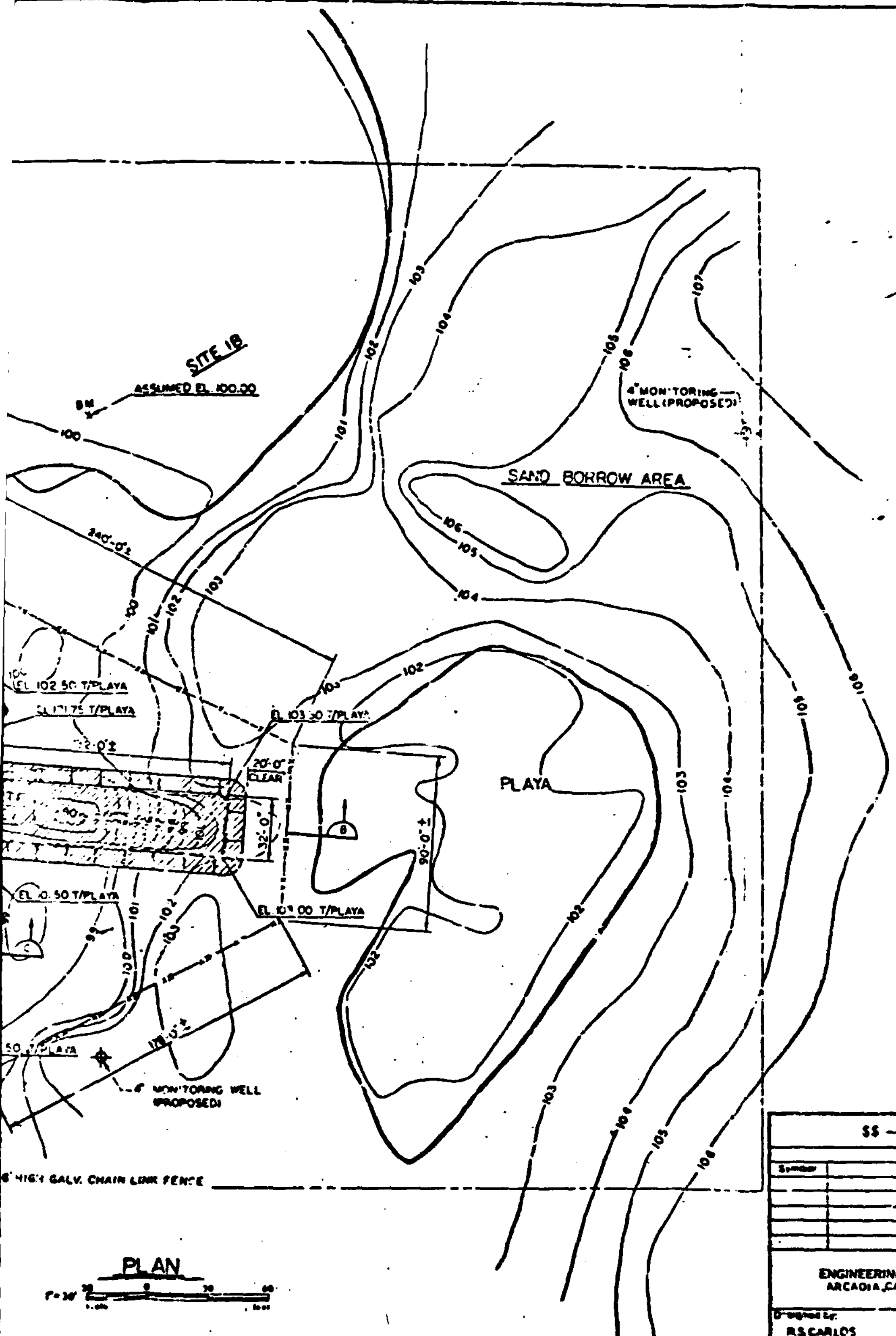
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

Designed by: R.S. CARLOS	EDWARDS A.F.B. CALIFORNIA
Drawn by: J.M. TREVINO	HAZARDOUS WASTE CLEANUP INSTALLATION RESTORATION PROGRAM (IRP) PHASE II
Checked by: R.S. CARLOS	SITE Nos. IA & IE PROPOSED SITE CONTOUR AND CROSS SECTIONS

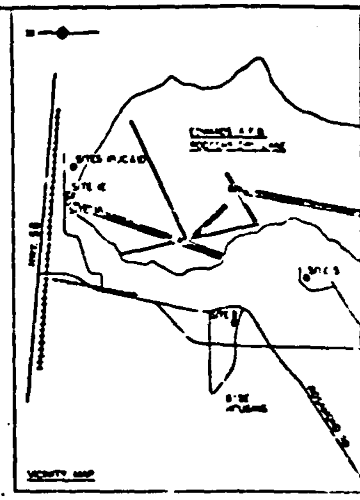
Reviewed by:	Scale: As Shown	Sheet reference number: 6	Date: 5 JULY 84
Submitted by:	Spec. No.: DACA 45		Drawing Code: AF890-15-01
	Contract No.: DACA 45		

3 2 1 D C B A


PLAYA
BORROW AREA
12' WIDE DOUBLE GATE
SITE 1B
BM
ASSUMED EL. 100.00
LIMITS OF PLAYA (TYP)
4" MONITORING WELL (PROPOSED)
195'-0"±
240'-0"±
EL. 103.50 T/PLAYA
23'-0"±
SITE 1C3
EXISTING MONITORING WELL
EL. 102.50 T/PLAYA
EL. 101.75 T/PLAYA
EL. 104.00 T/PLAYA
20'-0" CLEAR
132'-0"±
SITE 1C1
SITE 1C2
EL. 103.50 T/PLAYA
146'-0"±
4" MONITORING WELL (PROPOSED)
EL. 101.50 T/PLAYA
EL. 103.00 T/PLAYA
EL. 102.50 T/PLAYA
EL. 101.50 T/PLAYA
227'-0"±
4" MONITORING WELL (PROPOSED)
6' HIGH GALV. CHAIN LINK FENCE
GENERAL CLEANUP AREA CONTRACTOR TO REMOVE ALL SURFACE DEBRIS IN THIS AREA
4" MONITORING WELL (PROPOSED)
PLAN
D
C
B
A
5
4
3



PLAN



LEGEND

EXISTING | NEW

- ROADS
- CONTOURS
- SPOT GRADE ELEVATIONS
- DIRECTION OF DRAINAGE
- CHAIN LINK SECURITY
- BARBED WIRE
- MONITORING WELL
- LYSIMETER
- BENCH MARK
- PLAYA CLAY COVER
- POWER POLE
- EXCLUSION ZONE
- EXISTING EARTH
- FILL EARTH
- CONCRETE
- CRUSHED ROCK

SECTION LETTER
SHEET NUMBER OF DRAWING WHERE SECTION IS SHOWN*
SHEET NUMBER OF DRAWING WHERE SECTION IS CUT*

SECTION IDENTIFICATION

* SHEET NUMBERS OMITTED IF SECTION IS CUT AND DETAILED ON SAME DRAWING

$$ — THINK VALUE ENGINEERING — $$

Revisions			
Symbol	Descriptions	Date	Approved

ENGINEERING-SCIENCE
ARCADIA, CALIFORNIA

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA NEBRASKA

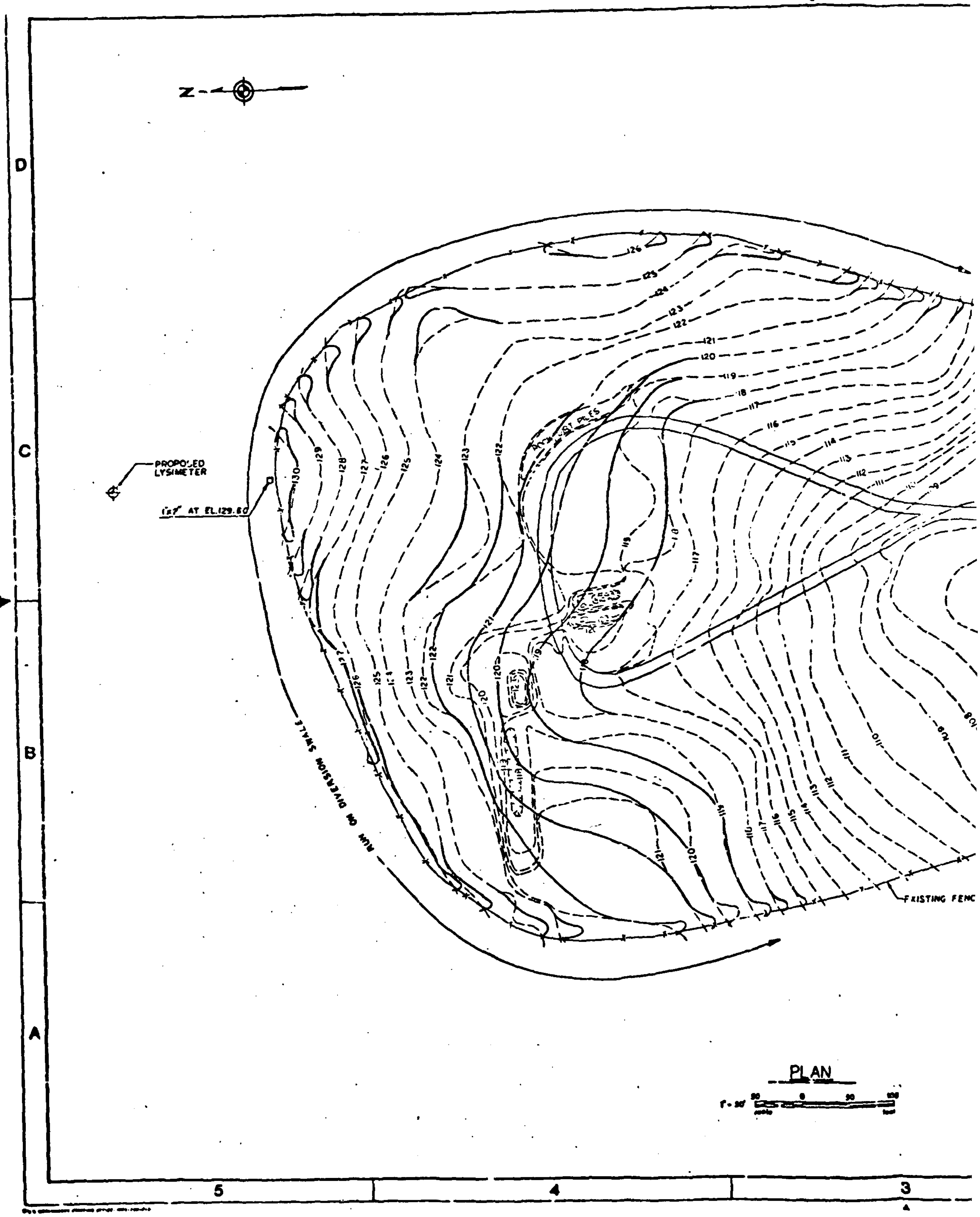
Designed by: R.S. CARLOS
Drawn by: J.M. TREVINO
Checked by: R.S. CARLOS
Reviewed by:
Submitted by: Architect Engineer

EDWARDS A.F.B. CALIFORNIA
HAZARDOUS WASTE CLEANUP
INSTALLATION RESTORATION PROGRAM (IRP)
PHASE II

SITE Nos. IB, IC & ID
PROPOSED SITE CONTOUR

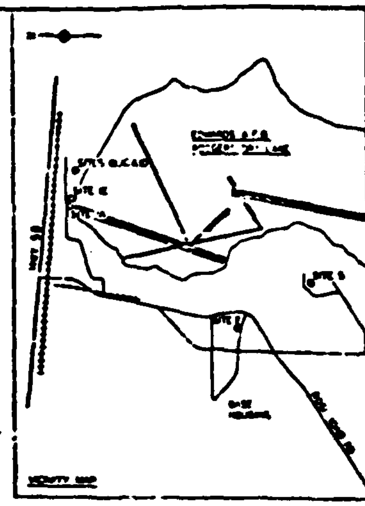
Scale: As Shown
Spec. No. DAC...
Contract No. DACA 45 CO
Sheet reference number: 7
Date: 6 JUNE '84
Drawing Code: AF890-15-01

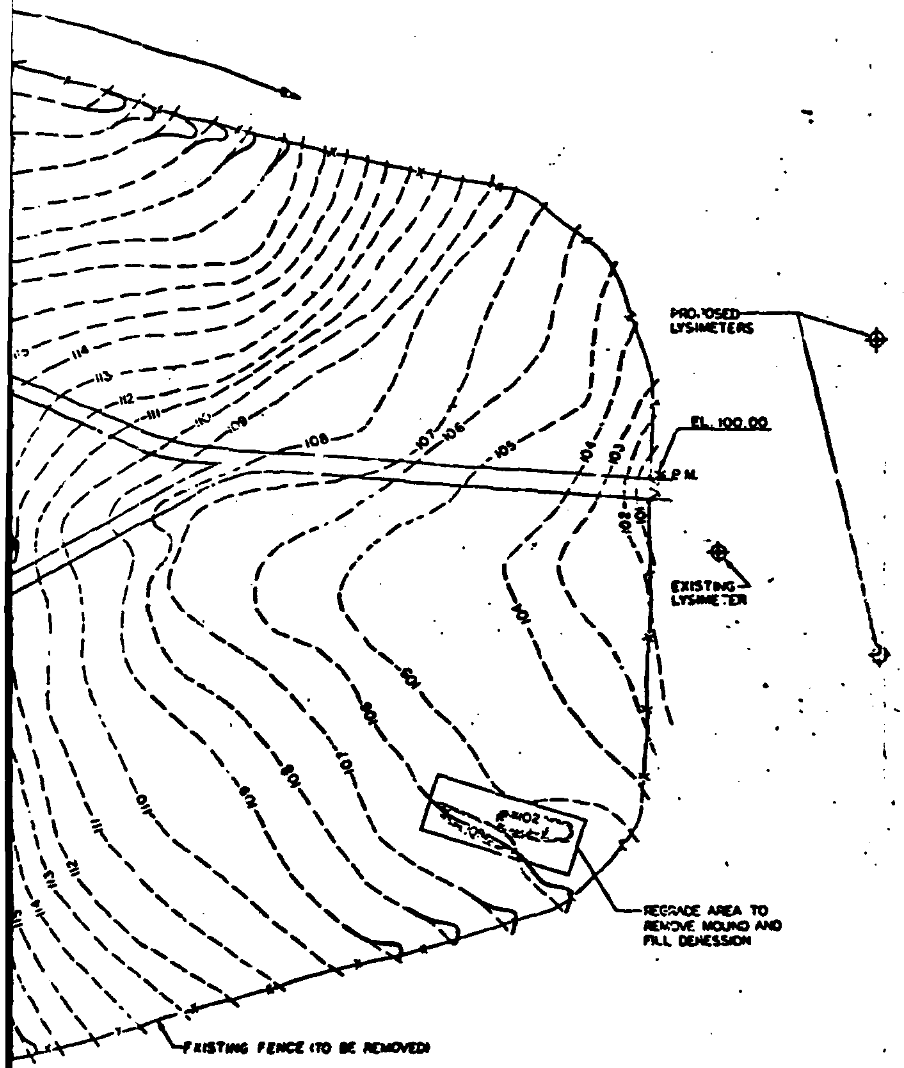
D
C
B
A
3
2



D
C
B
A
PROPOSED LYSIMETER
1'x7' AT EL.129.60
RIM OF DIVERSION SWALE
EXISTING FENC
5
4
3

PLAN





PLAN

GENERAL NOTES

1. EXISTING SIGNS WITHIN FENCED AREA TO BE REMOVED.
2. REMOVE SURFACE DEBRIS WITHIN EXISTING FENCE AND HAUL TO MAIN BASE SANITARY LANDFILL.

LEGEND

EXISTING / NEW

ROADS
CONTOURS
SPOT GRADE ELEVATIONS
DIRECTION OF DRAINAGE
CHAIN LINK SECURITY
BARBED WIRE
MONITORING WELL
LYSIMETER
BENCH MARK
PLAYA CLAY COVER
POWER POLE
EXCLUSION ZONE
EXISTING EARTH
FILL EARTH
CONCRETE
CRUSHED ROCK

SECTION LETTER
SHEET NUMBER OF DRAWING WHERE SECTION IS SHOWN *
SHEET NUMBER OF DRAWING WHERE SECTION IS CUT *

SECTION IDENTIFICATION

* SHEET NUMBERS OMITTED IF SECTION IS CUT AND DETAILED ON SAME DRAWING

$$ — THINK VALUE ENGINEERING — $$

Revisions

Symbol	Descriptions	Date	Approved

ENGINEERING-SCIENCE
ARCADIA, CALIFORNIA

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

EDWARDS A.F.B. CALIFORNIA

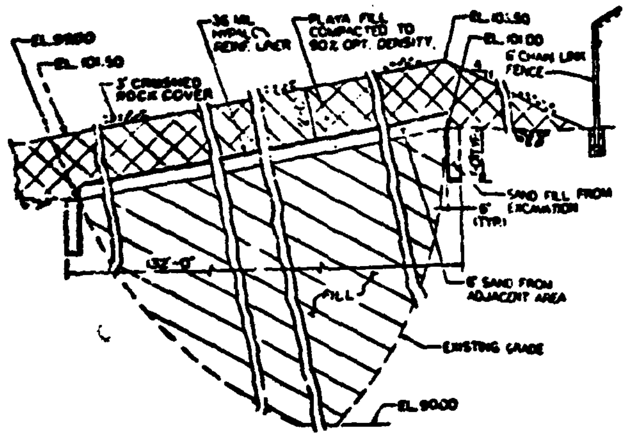
HAZARDOUS WASTE CLEANUP
INSTALLATION RESTORATION PROGRAM (IRP)
PHASE III

SITE No. 2
PROPOSED SITE CONTOUR

Designed by:	R. S. CARLOS
Drawn by:	S. P. STAWICKI
Checked by:	R. S. CARLOS
Reviewed by:	W.L. Chostyakov
Submitted by:	J. Charlton
Scale:	As Shown
Spec. No.	DACA 45
Contract No.	DACA 45 CO
Sheet reference number:	8
Date:	7 JUNE '84
Drawing Code:	AF890-15-01

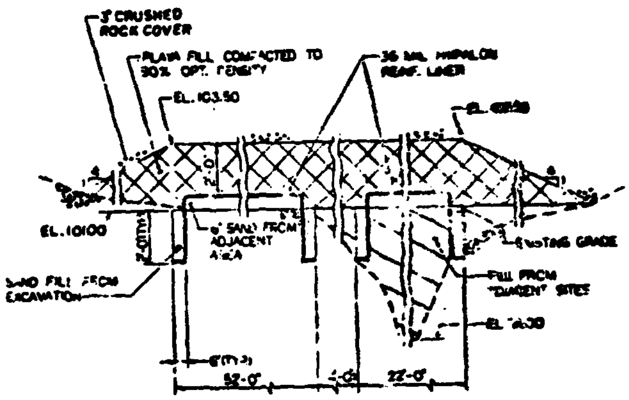
3 2

D

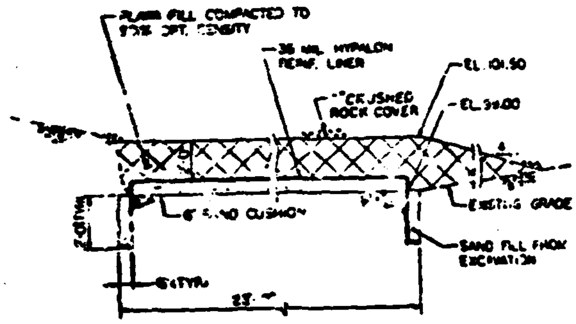


SECTION B-B
SHEET No. 7

C



SECTION D-D
SHEET No. 7



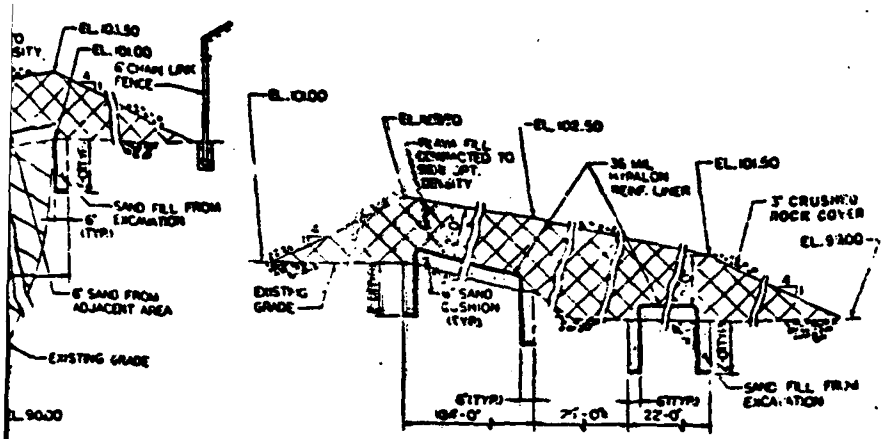
SECTION E-E
SHEET No. 7

B

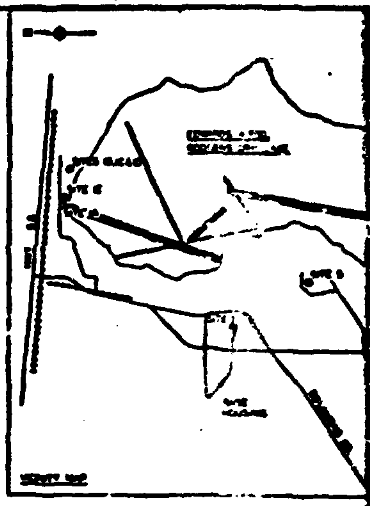
3/8"=1'-0" scale 0 2 4 6 feet

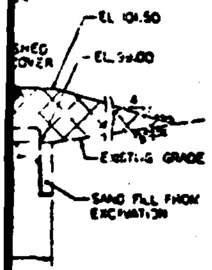
A

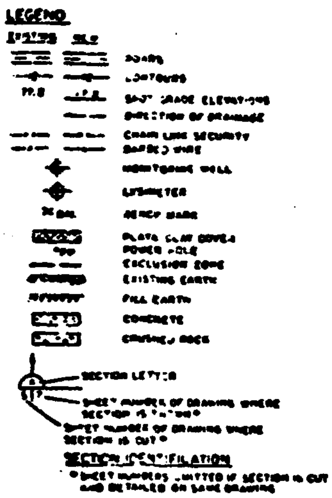
5 4 3



SECTION C-C
SHEET No. 7







$$ — THINK VALUE ENGINEERING — $$

Symbol	Descriptions	Date	Approved

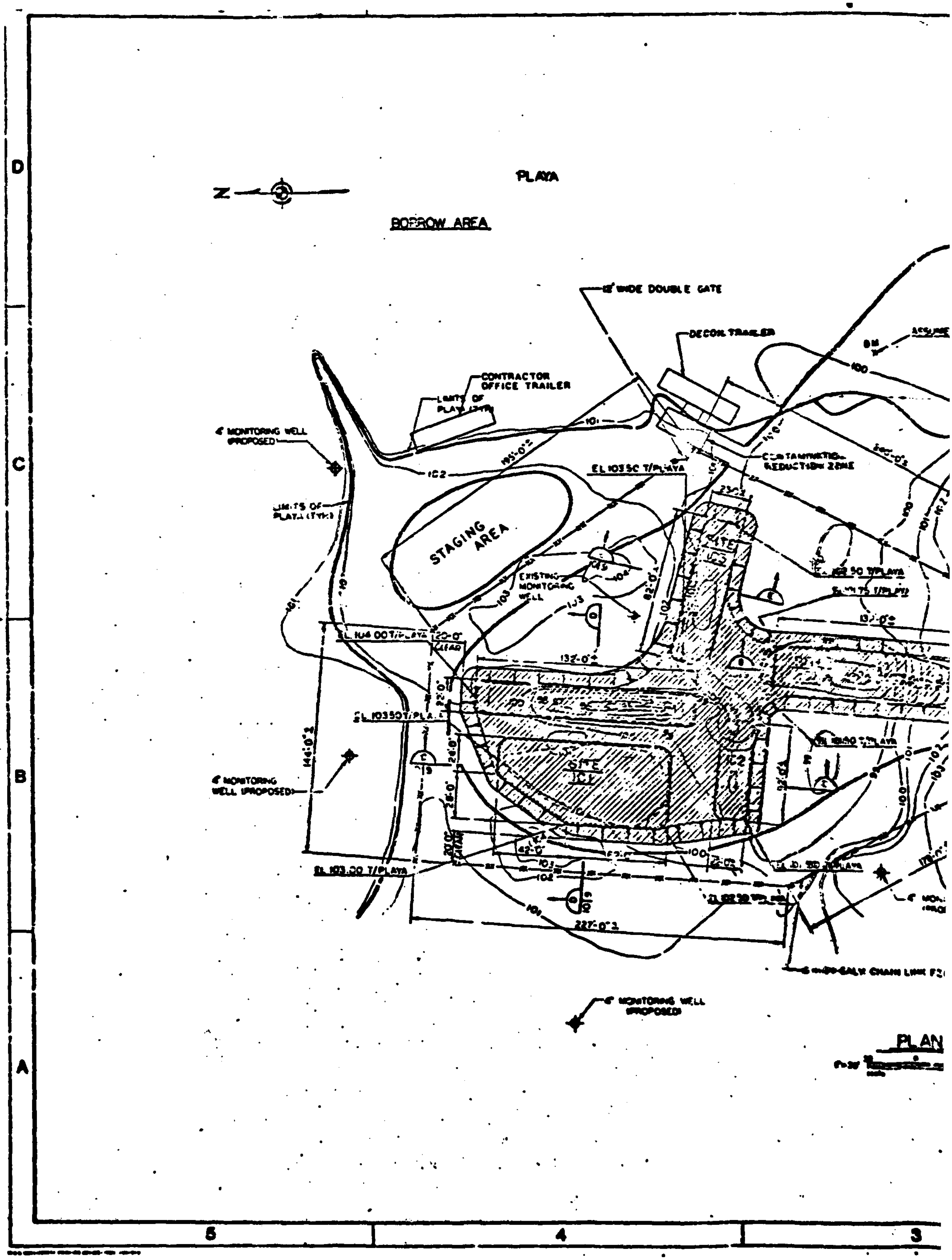
ENGINEERING SCIENCE
ARCADIA, CALIFORNIA

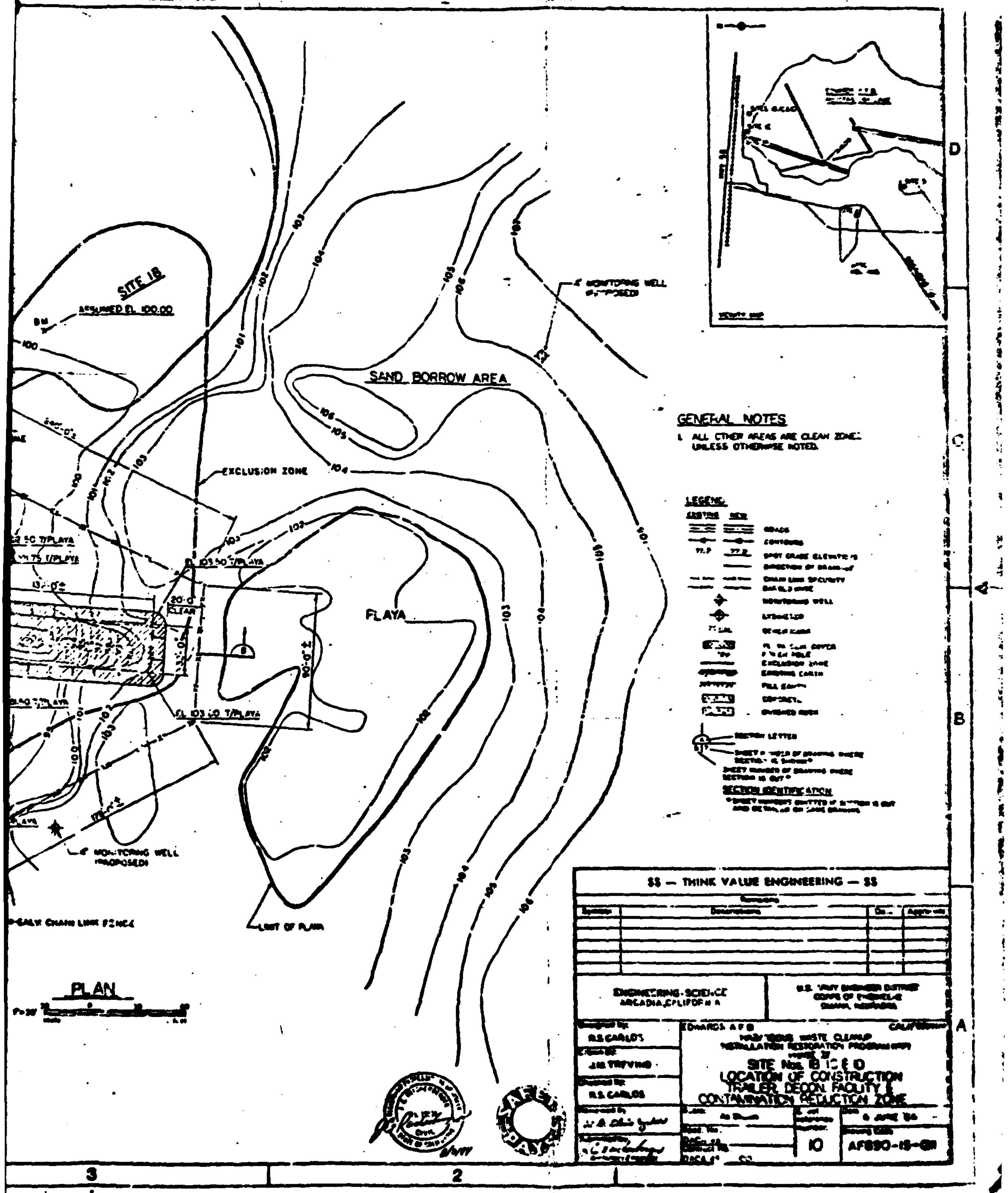
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

Designed by: R. S. CARLOS
Drawn by: S. P. STRANGIS
Checked by: R. S. CARLOS

EDWARDS AF.B CALIFORNIA
HAZARDOUS WASTE CLEANUP
INSTALLATION RESTORATION PROGRAM (IRP)
PHASE II
SITE Nos. 1B, 1C & 1D
SECTIONS

Scale: As Shown
Date: 8 JUNE '34
Drawing Code: 4F890-15-01
9


PLAYA
BORROW AREA
DECON TRAILER
CONTRACTOR OFFICE TRAILER
4" MONITORING WELL (PROPOSED)
STAGING AREA
EXISTING MONITORING WELL
CONTAMINATION REDUCTION ZONE
SITE
PLAN
D
C
B
A
5
4
3


SITE 18
ASSUMED EL 100.00
SAND BORROW AREA
EXCLUSION ZONE
MONITORING WELL (PROPOSED)
PLAYA
LIMIT OF PLAYA
GALV. CHAIN LINK FENCE
20'-0" CLEAR
GENERAL NOTES
1. ALL OTHER AREAS ARE CLEAN ZONES UNLESS OTHERWISE NOTED.
LEGEND
SECTION IDENTIFICATION
PLAN
$$ — THINK VALUE ENGINEERING — $$
ENGINEERING-SCIENCE
ARCADIA, CALIFORNIA
EDWARDS A F B
CALIFORNIA
SITE Nos. 18 1C & D
LOCATION OF CONSTRUCTION TRAILER, DECON FACILITY & CONTAMINATION REDUCTION ZONE
R.S. CARLOS
J.M. TREVINO
R.S. CARLOS
6 JUNE '84
10
AFB90-18-GH
3
2
A
B
C
D

APPENDIX A

BIOGRAPHICAL DATA ON PROJECT TEAM PERSONNEL

APPENDIX A

LIST OF KEY PROJECT TEAM PERSONNEL

W. G. Christopher, P.E. - Project Manager

T. N. Sargent, P.E. - Principal-in-Charge

E. J. Schroeder, P.E. - Technical Advisor

D. R. Kasper, P.E. - Technical Advisor

E. V. Clements, P.E. - Senior Project Engineer (Remedial Action Plan)

A. O. Kubala, P.E. - Senior Project Design Engineer (Design)

H. D. Harman - Senior Hydrogeologist

B. E. North, Ph.D. - Health and Safety Specialist

R. S. McLeod, P.D. - Senior Hydrologist

R. S. Carlos - Design/Construction Engineer

R. W. Wemyss - Civil Engineering Designer

R. W. Adam - Staff Engineer

J. N. Baker - Geologist

D. R. Boline, Ph.D., P.E. - Chemist

P. L. Kaye - Field Engineer

Biographical Data

WILLIAM GARY CHRISTOPHER

Environmental Engineer

PII Redacted [redacted]

Education

B.S.C.E. in Civil Engineering, (Magna Cum Laude), 1974, West Virginia University, Morgantown, W.Va.
M.E. in Environmental Engineering, 1975, University of Florida, Gainesville, Florida

Professional Affiliations

Registered Professional Engineer (Georgia No. 11886)
American Society of Civil Engineers (Associate Member)
West Virginia Water Pollution Control Federation

Honorary Affiliations

Chi Epsilon
Tau Beta Pi
EPA Traineeship for Master's Degree

Experience Record

1972-1974 West Virginia Department of Highways. Morgantown, West Virginia. Highway Co-op Technician. Handled inspection of drainage, concrete structures, earthwork and compaction testing for interstate highway construction within Monongalia County and Preston County. Performed field office assignments to finalize estimates and quantities for a completed section of highway construction.

1975-1977 Union Carbide Corporation, Chemicals and Plastics Division, Environomental Engineering Department. As a process/project engineer performed environmental protection engineering for Union Carbide's Taft and Texas City Plants. Projects included evaluation of source waste reduction and water reuse alternatives for two production units at the Texas City Plant, and process design of a rapid mix-flocculation basin for the Gulf Coast Waste Disposal Authority (GCWDA) 40-Acre Facility Treatment Plant. Performed bench-scale studies of coagulant use to improve settling of aeration basin effluent biosolids at the 40-acre facility. Predicted 40-acre facility effluent BOD and effluent TSS quality

William G. Christopher (Continued)

following operation changes to the existing facility including addition of a limited aeration basin to the front end of the treatment plant. Performed process feasibility and conceptual design of an aeration treatment facility for Union Carbide's Texas City plant concentrated waste stream. Performed preliminary process scope and cost appraisals for sludge disposal alternatives at Texas City including: landfarming, pressure filtration-landfill and pressure filtration-incineration. Performed settling column studies for solvent vinyl resin and suspension vinyl resin waste streams and sized settling basins from the studies. Proposed bench-scale study of the effect of ethyleneamines waste stream on anaerobic treatment of Texas City concentrated wastes. Provided review assistance for a 200-acre regional industrial landfill, in-place stabilization processes for 18-acre lagoons of primary sludge and pyrolysis fuel oil mixtures at Texas City, and source reduction projects. Evaluated at UNOX compressor piping modification for the Taft Plant to reduce power consumption by 50%. Wrote preliminary operational considerations for a proposed GCWDA regional landfarm.

1977-Date Engineering-Science, Inc. Project Engineer on study for the American Textile Manufacturers Institute and EPA. Responsible for field pilot plant study and evaluation of coagulation/clarification/multi-media filtration, carbon adsorption, ozonation, coagulation/multi-media filtration and dissolved air flotation technologies for treatment of textile industry "BPT" effluents to meet future BATEA guidelines. An ancillary portion of this project included review of existing activated sludge facilities and operational practices to meet current "BPT" limits at 5 textile mill sites.

Project engineer on study for Lederle Laboratories, Pearl River, New York plant. Responsible for wastewater treatment plant evaluation and optimization study with particular emphasis on operational changes to improve performance. Treatment processes included coagulation, flocculation, primary sedimentation, oxygen activiated sludge and final sedimentation.

Project manager of waste treatment operations evaluation at a pharmaceutical plant. Responsibilities included operational optimization of the full-scale activated sludge process with full-scale coagulation testing, bench-scale bioreactor studies and equalization mixing and capacity studies.

William G. Christopher (Continued)

Project engineer on study to determine the impact of RCRA regulations on the coal-fired utility industry. Assisted in development of design criteria and cost methodology and estimates to compare the cost impact of RCRA 3004 and 4004 regulations on fly ash, bottom ash and FGD sludge disposal on a regional and nationwide basis.

Project Manager for review of a Permit Application and design for a proposed Hazardous Waste Disposal Facility in North Carolina.

Project Manager for preparation of a "white paper" for the Department of Energy to assess major impacts of proposed RCRA 3001, 3004 and 3006 regulations on industrial coal use for power generation.

Project Manager on study to determine biotreatability of new process wastes for a pharmaceutical chemical plant and to evaluate and define options for liquid waste incineration.

Project Manager on odor control study of process wastes for a major organic chemicals company. Responsible for laboratory bench-scale and field pilot plant study involving evaluation of liquid waste, air and steam stripping, chemical oxidation, ozonation, and activated carbon adsorption. Design criteria for a biological treatment system for the odor pretreatment effluent was also developed from bench-scale bioreactor studies.

Project Manager on a study to provide a preliminary evaluation of advanced waste treatment technologies required for upgrading an existing activated sludge facility treating organic chemical and pharmaceutical wastes with high COD and nitrogenous concentrations.

Project Manager on a biological treatability study to provide expanded waste treatment facilities for a major organic chemicals firm. Responsibilities included laboratory bench-scale and pilot scale treatability and sludge handling studies involving waste characterization, activated sludge treatability, aerobic digestion, gravity thickening, dissolved air flotation, belt filter press sludge dewatering, plate and frame pressure filter, vacuum filter (rotary precoat), and centrifugation for nine different raw waste streams.

William G. Christopher (Continued)

Project Manager for a project involving process selection and preliminary engineering design for a pulp and paper mill waste treatment facility.

Project Manager on Solid and Hazardous Waste study for a diverse chemicals and plastics production facility. Responsibilities included RCRA Interim Status Compliance, RCRA Manifest Implementation and plant training, RCRA Notification and Permit Part A applications. Detailed Solid Waste inventories by production unit and classification of wastes according to RCRA were developed. Segregation of wastes, recycle/recovery and ultimate disposal options including incineration and secure landfills were evaluated for the short-term. Long-term evaluations will be considered in Phase II of the Study.

Project Manager on Solid and Hazardous Waste study for a diverse organic chemicals manufacturing facility. Long-term alternatives for storage, handling, treatment and disposal of a variety of types of hazardous wastes were evaluated based on technical performance and economic comparisons. Alternatives evaluated included solid and liquid incineration, landfill, landfarm, solidification/fixation, and physical volume reduction (shredding,compaction). Developed a detailed Spill Control and Best Management Practices Manual.

Project Manager for a waste treatment plant capacity evaluation for a silicon wafer manufacturing facility. Bench-scale and pilot scale coagulation and settling column studies were performed in addition to field scale oxygen transfer tests to predict maximum design organic and hydraulic loadings for an existing activated sludge waste treatment facility.

Project Manager for a biological treatability study to determine the optimum conditions (temperature and hydraulic residence time) for removal of a specific organic currently produced at a chemical production facility.

Project Manager for nine Installation Restoration Programs (IRP) Phase I projects for the U.S. Air Force (Kelly AFB, Eglin AFB, Duluth AFB, Hancock AFB, DESC, England AFB, Lowry AFB, Elmendorf AFB, Dover AFB). Each of these projects utilized a project team of various disciplines (geology, chemical engineering, biology, environmental engineering) to assess the potential for environmental contamination migration resulting from past hazardous waste handling, storage,

William G. Christopher (Continued)

treatment and disposal practices. The project tasks included environmental audits, development of waste inventories and waste classification, assessment of site environmental setting, assessment of past waste handling practices (surface impoundments, landfills, storage areas, fire training areas) and finally priority ranking of sites and recommendations for Phase II groundwater monitoring programs.

Project manager for development of an environmental audit manual for a pharmaceutical/food processing industry client. Audit areas included: air, drinking water, hazardous waste, infectious waste, non-hazardous waste, radioactive waste, spill control, superfund, toxic substances, wells, and wastewater.

Project manager for a preliminary design for upgrading an existing activated sludge facility (175,000 gpd) to accommodate expanded pharmaceutical and chemical production facilities. The modifications included provisions for additional submerged aeration capacity, solids contact clarification and mixed equalization.

Lead project engineer and deputy project manager for hazardous waste site assessment and cleanup project for Alcoa (Richland County, Illinois). Activities included waste characterization of primarily PCB contaminated wastes; geophysical survey; monitoring well installation, sampling and analyses of ground water, soil, sediment and surface water; assessment of contamination; remedial action evaluation; remedial design for liquid treatment to meet a 1 ppb effluent PCB level, and oil, sludge and soil disposal; preparation of construction bid package; selection of contractors; construction management; and preparation of final closure plan.

Technical Publications

"Magnesium Recovery from a Neutral Sulfite Semi-chemical Pulp and Paper Mill Sludge," Master of Engineering Research Project, University of Florida, Gainesville, Florida 1975.

"Siting Considerations for Hazardous Waste Disposal Facilities," presented at the Georgia Environmental Health Association Conference, Jekyll Island, Georgia, July, 1981. (Coauthor T.N. Sargent)

"Hazardous Waste Management," Seminar presented to Capitol Associated Industries, Inc., Raleigh, North Carolina, August 21, 1981

William G. Christopher (Continued)

"Ground-Water Monitoring" Seminar and Workshop presented to the State of Mississippi, Bureau of Pollution Control, Jackson, Mississippi, February 16-17, 1982. (Co-presentors - J. R. Absalon, E.J. Schroeder).

"Ground-Water Monitoring and Sampling" Seminar and Workshop presented to the State of Alabama, Huntsville, Alabama, July 20-21, 1982. (Co-presentors - J. R. Absalon, R. E. McLeod).

"Ground-Water Monitoring and Sampling" Seminar and Workshop presented to the State of Kentucky. Bowling Green, Kentucky, July 27-28, 1982. (Co-presentors - J. R. Absalon, R. E. McLeod).

"Preliminary Assessment of Past Hazardous Waste Storage, Treatment and Disposal Sites" presented to the Association of Engineering Geologists, Atlanta, Georgia, September 17, 1982.

"Assessment and Cleanup of Hazardous Waste Sites", Seminar presented at Clemson University, April 14, 1983.

"Contaminated Ground Water and Surface Water Treatment at Uncontrolled Hazardous Waste Sites" presented to the 12th Annual Conference on Waste Technology NSWMA. Memphis, Tennessee, October 15, 1983.

"Evaluation of Superfund Sites for Control of Leachate Contaminant Migration." (Coauthor R. S. McLeod). To be presented at the 5th Annual HMCRI Conference in Washington, D.C., October 1984.

ES ENGINEERING-SCIENCE

Biographical Data

THOMAS N. SARGENT

Sanitary Engineer

PII Redacted

[redacted]

Education

B.S. in Civil Engineering, 1967, University of Kentucky, Lexington
M.S. in Civil (Sanitary) Engineering, 1968, University of Kentucky, Lexington

Professional Affiliations

Registered Professional Engineer (Georgia No. 8412)
American Academy of Environmental Engineers (Diplomate)
American Institute of Chemical Engineers
American Society for Testing and Materials
Society of American Military Engineers
Water Pollution Control Federation

Honorary Affiliations and Awards

Chi Epsilon
FWPCA Water Pollution Traineeship
Kentucky Department of Highways Undergraduate Scholarship

Experience Record

1963-1967 — Kentucky Department of Highways. Summer Aide. Responsibilities included surveying, survey party direction, and construction inspection and supervision.

1967-1969 — Howard K. Bell, Consulting Engineers, Lexington, Kentucky. Engineer. Responsibilities included directing survey groups, conceptual design, and review of plans.

1969-1976 — U.S. Environmental Protection Agency. Project Engineer, Athens, Georgia (1969-1975). Responsibilities included planning and implementation of research, development, and demonstration of advanced wastewater treatment processes for application in the textile, pesticide, and fertilizer manufacturing industries.

Thomas N. Sargent (Continued)

Branch Chief, Food and Wood Products Branch, Industrial Pollution Control Division, Industrial Environmental Research Laboratory, Cincinnati, Ohio (1975-1976). Responsible for the implementation and coordination of programs to develop and demonstrate cost-effective technologies to prevent, control, or abate multimedia pollution associated with processing and manufacturing food and beverages, wood products, and other renewable resources. Also responsible for supervision of sampling and analysis and quality assurance programs. Represented the laboratory and division at technical meetings, conferences, and seminars with regard to sampling and analysis, quality assurance, and bioassays.

1977-Date Engineering-Science. Manager of Industrial Wastes (1977-1978). Served as Technical Director and Project Director for numerous industrial waste studies and multimedia environmental studies for industries, government agencies, and international concerns. Areas of concentration included air and water pollution control, solid waste management, and environmental impact assessment.

Manager of Engineering Development (1978-1983). Responsible for the development of engineering programs for industry and government. Provides technical and program direction for major environmental projects in all media as well as extensive consultation with clients regarding RCRA impacts and compliance. Projects include an evaluation of the impact of RCRA regulations on the public utility industry; EIA/EIS determinations, PSD analysis, and BACT preparation for St. Regis Paper; a third party EIS on proposed phosphate mining for Mobil Chemical; and the preliminary EIS for an Adolph Coors Company proposed brewery site.

Served as Project Manager and Director for hazardous and solid waste management programs. Completed nine technical assistance projects to evaluate solid waste management programs for municipalities in the southeast sponsored by EPA. Directed Phase I Installation Restoration Programs at more than twenty U.S. Air Force bases to identify past hazardous waste practices that could result in migration of contaminants. Investigated past solid waste disposal practices including landfills, incineration, and deep wells for an industrial client to assess future waste disposal

Thomas N. Sargent (Continued)

alternatives such as contract disposal and development of upgraded landfill and incineration facilities. Directed an industrywide study assessing the impact of RCRA legislation on the coal-fired power industry which evaluated technology for fly ash disposal and economic impact of solid waste disposal costs on power generation costs.

Vice President (1983-Date). Responsible for project management, program development, and client liaison for major multimedia environmental projects with particular emphasis on regulation review and interpretation for government and industry.

Publications

"Discussion of BOD from Poultry Processing Plants, by C. C. Griffith," Purdue Industrial Waste Conference Proceedings, Engineering Extension Series No. 135, Purdue University, West Lafayette, Indiana, 6-8 May 1969 (Coauthors D. W. Hill and J. L. Dause).

"Water Pollution and the Poultry Industry," Proceedings of Poultry Waste Management Seminar, University of Georgia, Athens, Georgia, 28 May 1969 (Coauthors D. W. Hill and J. L. Dause).

"Protection of Streams and Lakes and Adjacent Lands from Mining and Related Industrial Wastes," Proceedings of Symposium on Rehabilitation of Drastically Disturbed Surface Mined Lands, November 1971.

"Chemical/Physical and Biological Treatment of Wool Processing Wastes," Proceedings of 28th Purdue Industrial Waste Conference, Purdue University, West Lafayette, Indiana, 1-3 May 1973 (Coauthors L. T. Hatch, R. E. Sharpin, and W. T. Wirtanen).

"Waste Loads and Water Management in Catfish Processing," Journal of Water Pollution Control Federation, Vol. 46, No. 9, September 1974, pp. 2193-2201 (Coauthor L. A. Mulkey).

"Activated Sludge and Alum Coagulation of Textile Wastewaters," Proceedings of 29th Purdue Industrial Waste Conference, Purdue University, West Lafayette, Indiana, 7-9 May 1974 (Coauthor T. L. Rinker).

"Treatment of Textile Wastewaters in a Biological-Chemical System," Proceedings of Seventh Mid-Atlantic Industrial Waste Conference, Drexel University, Philadelphia, Pennsylvania, November 1974 (Coauthor T. L. Rinker).

Thomas N. Sargent (Continued)

"Reuse of Total Composite Wastewater Renovated by Hyperfiltration in Textile Dyeing Operations," Proceedings of National Conference on Management and Disposal of Residues from the Treatment of Industrial Wastewaters, Washington, D.C., 3-5 February 1975 (Coauthors C. A. Brandon and J. J. Porter).

"Recent Advances in Technology for Treatment of Textile-Industrial Wastewaters," Proceedings of Industrial Waste Treatment Symposium, Sanitary Engineering Institute, Krakow Polytechnic Institute, Krakow, Poland, June 1975.

"Renovation of Textile Dyeing and Finishing Wastewaters by Hyperfiltration for Pollution Abatement by Resource and Energy Recovery through Complete Recycle," DECHEMA Monograph, Volume 80, June 1976, pp. 191-210 (Coauthor C. A. Brandon).

"Waste Treatment vs. Waste Recovery," Textile Chemist and Colorist, Vol. 9, No. 11, November 1977, pp. 269-273 (Coauthor J. J. Porter).

Papers and Presentations

"EPA Research Programs and the Fertilizer Industry," presented at Fertilizer Institute Fall Meeting, Atlanta, Georgia, 7 October 1971 (Coauthor R. R. Swank).

"The EPA Research and Development Program Cooperative Efforts with Industry," presented at American Dye Manufacturers Institute Annual Meeting, Absecon, New Jersey, September 1974.

"Hyperfiltration for Renovation of Composite Wastewater at Eight Textile Finishing Plants," presented at SEPAR/EXPO III-Third Annual Conference on New Advances in Liquid/Solids Separation Technology, Cherry Hill, New Jersey, October 1977 (Coauthors C. A. Brandon and M. Samfield).

"Hazardous Waste Site Rating System," presented to the Textile Wastewater Treatment and Air Pollution Control Conference,, Hilton Head Island, South Carolina, January 1983 (Coauthor E. J. Schroeder).

Biographical Data

ERNEST J. SCHROEDER

Environmental Engineer

PII Redacted

[redacted]

Education

B.S. in Civil Engineering, 1966, University of Arkansas, Fayetteville

M.S. in Sanitary Engineering, 1967, University of Arkansas, Fayetteville

Professional Affiliations

Registered Professional Engineer (Arkansas No. 3259, Florida No. 0029175, Georgia No. 10618, and Texas No. 33556)

American Academy of Environmental Engineers (Diplomate)

Water Pollution Control Federation

Honorary Affiliations

Chi Epsilon

Experience Record

1967-1976 Union Carbide Technical Center, Engineering Department, South Charleston, West Virginia. Project Engineer (1967-1969). Responsible for environmental protection engineering projects for various organic chemicals and plastics plants. Involved in industrial waste surveys, landfill design, and planning for plant environmental protection programs; evaluated air pollution discharges from new sources; reviewed a wastewater treatment plant design report; and participated on a project team to design a new chemical unit.

Project Engineer and Engineering Supervisor, Environmental Protection Department, Texas City, Texas (1969-1975). Responsible for various aspects of plant pollution abatement programs, including preparation of state and federal permit applications for wastewater treatment activities. Served as operations representative on an $8 million regional wastewater treatment project. Participated in contract negotiations, process and detailed engineering design, construction of facilities, preparation of start-up manuals,

Ernest J. Schroeder (Continued)

operator training, and start-up activities. Designated as project engineer on expansion to original waste treatment unit.

Engineering Supervisor. Responsible for operation of wastewater treatment facilities including collection system, sampling and monitoring programs, primary treatment, wastewater transfer system, biological treatment, and pilot treatment plants. Developed odor control and spill control and cleanup programs. Led special programs to reduce excess water pollution losses, separate contaminated and noncontaminated water, develop long-term sludge disposal alternatives, and recover land in present sludge landfill area. Developed improved methods of sampling and continuous monitoring of wastewater.

Environmental Protection Project Engineer, Toronto, Ontario, Canada (1975-1976). Responsible for the environmental permitting, engineering design, construction, and start-up of wastewater treatment systems at a new refinery.

1976-Date Engineering-Science. Project Manager (1976-1978). Responsible for various industrial wastewater treatment and hazardous waste disposal projects. Supervised wastewater characterizations, waste reduction studies, and sludge settling studies of chemical plant wastewaters. Responsible for process document development for a petrochemical wastewater treatment facility as well as a comprehensive wastewater treatment evaluation. Managed a hazardous waste disposal project involving waste characterization, detailed design, and construction of disposal facilities. Also supervised an industrywide pilot study of advanced waste treatment in the textile industry.

Manager, Industrial Waste Group (1978-1980). Responsible for the supervision of industrial waste management projects. Provided consulting services for clients on environmental studies and environmental assessments including several spill control and wastewater treatability projects as well as a third-party EIS for a new phosphate mine in Florida.

Manager, Solid and Hazardous Waste Group (1980-Date). Responsible for the supervision of solid and hazardous waste management projects. Activities include permitting and regulatory assistance; waste management program development; groundwater monitoring; landfill site evaluations and closure design; waste inventory;

Ernest J. Schroeder (Continued)

evaluations of waste collection, handling, transport, disposal, and recovery/recycle alternatives; and spill control and countermeasure planning. Managed studies for the Department of Defense involving evaluation of past and present solid and hazardous waste disposal practices, groundwater monitoring, and recommendations for future changes and priority site investigations. Conducted environmental audits and contamination assessments at industrial sites and developed site cleanup plans.

Publications

"Activated Carbon Adsorption for Textile Wastewater Pollution Control," Symposium Proceedings: Textile Industry Technology, Williamsburg, Virginia, December 1978 (Coauthor A. W. Loven Ph.D.).

"Pilot Plant Evaluation of the 1974 BATEA Guidelines for the Textile Industry," Proceedings of 35th Industrial Waste Conference, Purdue University, Indiana, May 1980 (Coauthor W. A. Storey).

Papers and Presentations

"Filamentous Activated Sludge Treatment of Nitrogen Deficient Waste," Master of Science Research Paper, University of Arkansas, Fayetteville, Arkansas, 1967.

"Summary Report of the BATEA Guidelines (1974) Study for the Textile Industry," presented to North Carolina Section of AWWA/WPCA, Pinehurst, North Carolina, November 1979.

"Industrial Solid Waste Management Program to Comply with RCRA," engineering short course presented at Auburn University, Alabama, October 1980.

"Technical and Economic Impact of RCRA on Industrial Solid Waste Management," presented to Florida Section of American Chemical Society, May 1981.

"Hazardous Waste Site Rating Systems," presented to Textile Wastewater Treatment and Air Pollution Control Conference, Hilton Head Island, South Carolina, January 1983 (Coauthor T. N. Sargent).

Biographical Data

DENNIS R. KASPER, Ph.D.

Environmental and Sanitary Engineer

PII Redacted

[redacted]

Education

B.S. in Civil Engineering, 1966, Loyola University, Los Angeles, California
M.S. in Civil Engineering, 1967, California Institute of Technology, Pasadena
Ph.D. in Environmental Engineering, 1971, California Institute of Technology, Pasadena

Professional Affiliations

Registered Sanitary Engineer (Arizona and California)
American Water Works Association
International Desalination Environmental Association
Water Pollution Control Federation
Water Supply Improvement Association

Honorary Affiliations

Alpha Sigma Nu
Tau Beta Phi

Experience Record

1972-1976 — University of Arizona, Phoenix, Arizona. Assistant Professor. Provided graduate and undergraduate instruction in civil engineering. Directed research involving removal of particulate matter from water by coagulation and flocculation, fates of metal ions leached from tailing ponds, filtration of algae from treated wastewaters, and transport of metal ions through porous media.

Also provided special consulting services to public utility companies, government agencies, and private corporations for development, design, and evaluation of water supply and water and wastewater treatment programs. Evaluated reverse osmosis treatment of brackish water and seawater, developed groundwater resource protection programs, and directed applied research program to identify cause of reverse osmosis membrane degradation for Oceanic Construction Company. Provided technical guidance in water and wastewater

Dennis R. Kasper, Ph.D. (Continued)

quality evaluations, establishment of long-term groundwater monitoring program, and design and modification of municipal water supply and sewage treatment systems.

1976-1982 PRC Toups Engineers. Senior Engineer (1976- 1980), Principal Engineer (1980-1981), and Associate Vice President (1981-1982). Responsible for direction and management of major projects involving water supply, water and wastewater treatment, water reclamation and reuse, and the assessment of quality interactions in groundwater systems. Specialized in study, evaluation, design, and start-up of desalination systems including reverse osmosis, electrodialysis/ultrafiltration, and ion exchange for the treatment of municipal, agricultural, and industrial wastewaters for reuse in irrigation, groundwater recharge, and industrial processes.

Served as technical director and project manager of feasibility study evaluating brackish water and seawater reverse osmosis for the Hong Kong Office of the Water Authority. Managed Desalting Demonstration Module design project for California Department of Water Resources to evaluate pretreatment and membrane systems for proposed 400-mgd agricultural wastewater desalting plants. Directed preliminary design of well fields, collection system, plant site, and reverse osmosis process for desalination of brackish water to supplement potable water supply on New Providence Island, Bahamas. Developed portable reverse osmosis pretreatment unit for naval field operations. On behalf of the U.S. Navy, developed a program to determine the extent of oil contamination on Diego Garcia and to define cleanup options.

Also specialized in environmental evaluation of mining operations and disposal of wastes generated by development of uranium, copper, silver, shale, and phosphate ore deposits. Managed extensive geologic and hydrologic investigation of silver mine site for 3M Inc. Served as technical director of study for a major energy company evaluating alternative methods for in situ disposal of uranium mining process and restoration wastewaters. Identified regulatory requirements and evaluated potential environmental impacts of in situ mining of various ores including phosphate, copper, and uranium deposits in Wyoming, Texas, New Mexico, Colorado, Nevada, and Arizona. Analyzed potential surface water and groundwater quality impacts of large-scale development of the

Dennis R. Kasper, Ph.D. (Continued)

Chattanooga shale uranium resource for the U.S. Department of Energy.

1982-Date — Engineering-Science. Project Manager. Provides technical support and supervision for major national and international water supply, water reclamation, and desalination projects. Designed a zero discharge industrial wastewater treatment system incorporating a vapor compression brine concentrator. Directed a one-year pilot evaluation of the standard military reverse osmosis water production unit for the Navy.

Publications

"Pretreatment for Membrane Desalination Systems," Journal of the National Water Supply Improvement Association, Vol. 6, No. 2, July 1979.

"Microbiological Investigation at the Yuma Desalting Test Facility," Technical Proceedings, National Water Supply Improvement Association Annual Conference, San Francisco, California, July 1980 (Coauthor K.M. Trompeter).

"Optimization of Reverse Osmosis Treatment of *in situ* Wastewaters," 55th Annual Conference Proceedings, Society of Petroleum Engineers of American Institute of Mining, Metallurgical and Petroleum Engineers, Dallas, Texas, 21-24 September 1980.

"Pilot Evaluations of Commercially Available Seawater Reverse Osmosis Membranes for Potential Use in Hong Kong," Technical Proceedings, National Water Supply Treatment Associates Annual Conference, Washington, D.C., May 1981 (Coauthors C.W. Lake, T.H. Lau, and M.Y. Pau).

"Energy Recovery at Paradise Island Seawater RO: 13 kWh/1,000 Gallons," Journal of the Water Supply Improvement Association, July 1982 (Coauthors L.C. Jenkinson, E. Ramsey, and N. Carey).

"Agricultural Wastewater Desalting in California DWR: Test Facility Description," Journal of the Water Supply Improvement Association, July 1982 (Coauthors B.E. Smith, D.B. Brice, and W.R. Everest).

Papers and Presentations

"Applications of Polymeric Coagulant in Water and Wastewater Treatment," presented to Arizona Water Pollution Control Association, Yuma, Arizona, April 1972.

Dennis R. Kasper, Ph.D. (Continued)

"Defluoridation Technology Alternatives and Costs," presented to Arizona Water Pollution Control Association, Tucson, Arizona, April 1977.

"Water Pollution Caused by Inactive Ore and Mineral Deposits," presented to Northwest Mining Association, Spokane, Washington, 1977.

"The Effects of Solution Composition on the Effectiveness of Polymeric Flocculants," presented at American Water Works Association Annual Conference, Atlantic City, New Jersey, June 1978.

"Compliance with Environmental Regulations for in situ Uranium Mining: From Discovery to Closure," presented at Bureau of Mines Technology Transfer Seminar on in situ Leaching and Borehole Mining of Uranium, Denver, Colorado, 26 July 1978 (Coauthor W. H. Engelmann).

"Reverse Osmosis Membrane Degradation," presented at National Water Supply Improvement Association Annual Conference, Sarasota, Florida, July 1978.

"Environmental Regulations for in situ Uranium Mining: From Exploration to Restoration," presented at AAPG Conference, Houston, Texas, 1 April 1979 (Coauthor W. H. Engelmann).

"Desalination Post-treatment: Systems Selection and Optimization," presented at National Water Supply Improvement Association Annual Conference, New Orleans, Louisiana, September 1979.

"Desalination Technology for Treatment of Wastewaters for Reuse," presented at Water Reuse Symposium II, Washington, D.C., 23-28 August 1981 (Coauthor S. Ellis).

Biographical Data

ERNEST V. CLEMENTS III

Environmental Engineer

PII Redacted

[redacted]

Education

B.S. in Aeronautical and Astronautical Engineering, 1971, University of Illinois (High Honors)
M.S. in Civil (Environmental) Engineering, 1972, University of Illinois

Professional Affiliations

Registered Professional Civil Engineer (California No. C-34482)
American Society of Civil Engineers
American Public Works Association (Solid Waste Institute)
Southern California Waste Management Forum
California Resource Recovery Association
National Resource Recovery Association

Honorary Affiliations

James Scholar (University of Illinois)
Phi Kappa Phi
Sigma Tau
Tau Beta Pi
George Huff Award (Scholarship and Athletics, University of Illinois)
USEPA Water Pollution Traineeship

Experience Record

1972-1981 SCS Engineers, Long Beach, California. Project Engineer (1972-1975). Responsible for all field and literature research, technological evaluations, and detailed cost analyses of a variety of solid waste collection system options for cities in Washington, Arizona, and California. Performed detailed solid and hazardous waste composition studies for a variety of U.S. Navy bases. Contributed to study of solid waste handling and disposal practices at a large U.S. Air Force base. Project involved field sampling to determine solid waste composition and the design and cost-benefit analysis of a complete system for storage, collection, transport, and disposal of all wastes generated on the base.

Ernest V. Clements III (Continued)

Project Manager (1975-1981). Responsible for planning and supervising solid and hazardous waste management and resource recovery projects. Prepared a Spill Control and Countermeasures Plan for the U.S. Navy base on San Clemente Island including design of fuel storage and fuel spill containment facilities. Evaluated the feasibility of areawide solid waste management and resource recovery for Yuma, Arizona. Prepared master plans for solid and hazardous waste management for American Indian reservations in California and Arizona, which involved development of plans for landfills and small transfer stations. Headed team of engineers in evaluating transfer station and sanitary landfill operations for Sacramento County, California.

Responsible for development of model to assess potential for wastewater reclamation/reuse at over 400 U.S. Army and Navy bases. Served as Deputy Project Manager for design of domestic wastewater treatment and reuse facilities for an IBM manufacturing complex near Tucson, Arizona.

1981-Date Engineering-Science. Environmental Engineer/Project Manager. Responsible for study and design projects involving hazardous waste management, solid waste collection and disposal, resource recovery, and waste-to-energy. Served as Deputy Project Manager on a study for Orange County, California, to develop a countywide solid and hazardous waste management system for the next 20 years, which involved evaluation of waste quantities and composition, hazardous waste generation, refuse transfer and landfill disposal, resource recovery alternatives, private versus public ownership and operation, institution of gate fees, and financial options.

Served as project manager for design of a hazardous waste landfill and preparation of RCRA Part B permit application for the W.R. Grace coal-to-methanol-to-gasoline plant in Baskett, Kentucky. Evaluated landfill disposal options for hazardous wastes from the U.S. Army's Johnston Island nerve gas destruction facility. Performed a RCRA permit audit for hazardous waste management, treatment, and transport to disposal for the Parker Chemical Company in Buena Park, California. Completed a comprehensive review of the California program to ban liquid hazardous wastes from land disposal for an EPA funded study of the treatment, recycle, and disposal of waste solvents in the U.S.

Ernest V. Clements III (Continued)

Defined hazardous waste streams, spill containment facilities, and environmental impact mitigation measures for a program to analyze hazardous waste containment and disposal options for Sohio's Endicott Oil Field development near Prudhoe Bay, Alaska. Managed a project for The Irvine Company, Newport Beach, California to evaluate technical, environmental, and cost factors associated with development of a large canyon site as a potential sanitary landfill. Managed the development of a solid waste plan for the City and Borough of Juneau, Alaska, which involved evaluation of waste quantities and composition, the feasibility of recycling and waste-to-energy systems, the development of a new landfill, and alternative sludge disposal techniques including co-combustion.

Managed a project for the White River Shale Oil Corporation to evaluate alternatives, including development of a new landfill, incineration, underground burial, and treatment, for disposal of hazardous wastes from the shale mining and processing operation. Responsible for coordinating data collection, conducting site investigations, preparing EPA Forms 2070-12 and 2070-13, and writing the attendant narrative descriptions for the State of Texas 3012 site investigation programs concerning potential hazardous waste sites.

Served as deputy project manager for preparation of a remedial action plan and concept design for cleanup of uncontrolled waste disposal sites, including acid pits, drum trenches, and underground POL storage tanks at Edwards AFB, California. Managed preparation of a RCRA Part B permit application for hazardous waste surface impoundments, storage facilities, and treatment units at Norton AFB, California.

1984-Date — Loyola Marymount University, Los Angeles, California. Instructor. Serves as part-time instructor for courses in hazardous and solid waste management.

Publications

"Wastewater Characterization for the Specialty Food Industry," Proceedings of the 29th Industrial Waste Conference, Purdue University, 1974 (Coauthors C. J. Schmidt and J. Farquhar).

"Treatment Alternatives for the Fruits and Vegetables Process Industry," Proceedings of the 30th Industrial Waste Conference, Purdue University, 1975 (Coauthors C. J. Schmidt and K. La Conde).

Ernest V. Clements III (Continued)

"Sewer Surcharges: How To Ease the Spiraling Cost of Wastewater Discharge," Canner/Packer, July 1975.

"Municipal Wastewater Reuse in the U.S.," Journal Water Pollution Control Federation, Vol. 47, No. 9, September 1975 (Coauthors C. J. Schmidt and I. Kugelman).

"A Survey of Practices and Regulations for Reuse of Water by Groundwater Recharge," Journal American Water Works Association, March 1978 (Coauthors C. J. Schmidt and S. P. Shelton).

Papers and Presentations

"Wastewater Reuse as a Conservation Measure," presented at the Governor's Conference on the Drought, Los Angeles, California, 1977.

"Solid Waste Collection and Transfer in Rural Areas," National Association of Counties Workshop on Rural Solid Waste Management, Tempe, Arizona, April 1981.

"Conducting a Landfill Gas Migration Investigation," presented at the California Environmental Health Association's 1983 Symposium, Cypress College, Cypress, California, October 1983.

"On-Site Remedial Actions at Hazardous Waste Sites," presented at the Sixth Annual Symposium on Management of Uranium Mill Tailings, Low-Level Waste, and Hazardous Waste, Colorado State University, February 1984 (Coauthor B. I. Loran).

"Chlorinated Disinfection for THM Control," presented at the American Society of Civil Engineers Environmental Engineering Conference, Los Angeles, California, June 1984 (Coauthors R. W. Bentwood, J. C. Reichenberger, and D. L. Suggs).

Biographical Data

ANDREW O. KUBALA

Civil and Structural Engineer

PII Redacted [redacted]

Education

B.C.E. in Structural Engineering, 1963, Fenn College (Cleveland State University)
Advanced Engineering Management, 1969-1971, Cleveland State University
Marketing Abroad Workshop, 1973, U.S. Department of Commerce

Professional Affiliations

Registered Professional Engineer (Ohio No. E037731, Pennsylvania No. 23586-E, and Wisconsin No. 18011)
American Society for Testing and Materials (Charter Member, ASTM Committee D-34 for Hazardous Waste)
American Society of Civil Engineers
National Society of Professional Engineers
Illinois Society of Professional Engineers

Honorary Affiliations

Tau Beta Pi

Experience Record

1959-1968	H. K. Ferguson Company. Civil/Structural Engineer. Responsible for civil and structural engineering portions of various petrochemical, steel, and electrical generating contracts. Clients included Anheuser Busch Breweries and Thicokol Chemical Company. Also served as computer programmer.
1963	San Francisco Naval Shipyard, Hunter's Point, San Francisco, California. Stress Analyst (concurrent position). Projects included ship repairs on submarines and aircraft carriers.
1964	Pacific Gas and Electric Company, San Francisco, California. Civil/Structural Specifications Writer (concurrent position).

Andrew O. Kubala (Continued)

1965-1975	Private Engineering Consultant (concurrent position). Responsible for structural design and material handling projects for McDowell-Wellman, Heyl Patterson, and various engineers and architects.
1968-1970	NESCO Inc., Cleveland, Ohio. Project Engineer. Projects involved large bulk material handling systems and machines.
1970-1973	Hydraulic Press Brick Company. Sales Manager/Corporate Plant Engineer. Responsible for corporate technical sales and plant engineering for manufacture of lightweight aggregate.
1973-1976	NESCO Inc., Cleveland, Ohio. Structural Engineer. In charge of mechanical, structural, and material handling projects for Struthers-Wells, Heyl Patterson, Kippers, Dravo, and A. G. McKee. Also served as Chief Engineer of Morris Knowles, Inc., a NESCO subsidiary specializing in water and wastewater treatment.
1976-Date	Engineering-Science. Manager of Industrial Development (1976-1977). Responsible for civil and structural engineering studies and design projects.

Vice President and Senior Project Manager (1977-Date). Responsible for studies, design, and startup on various projects for industry and government. Projects include water use and suggested wastewater treatment studies, detailed engineering, and construction for Babcocks and Wilcox Company and ITW/ Shakeproof as well as a high rate filtration plant for Atlas Steel. Supervised various engineering, purchasing, and design assistance projects for Argonne National Laboratory in the area of utility utilization and potable water and natural gas supply. Designed a hazardous waste lagoon for temporary storage of potentially radioactive waste from ANL cooling systems. Supervised design of solid waste handling and disposal systems for Waste Management, Inc. Supervised studies to treat 40 mg of water collected at two waste disposal sites and secured state permits to discharge treated water for Chem-Waste.

Supervised the study and design of a system to collect and treat resin wastes for the Cargill, Inc. manufacturing plant. Supervised a study at 22 Illinois Tool Works plants to determine the impact of RCRA regulations on the Corporation, and prepared Preliminary Notification Forms and Part A RCRA Application Forms. Supervised studies, design, and construction of water

Andrew O. Kubala (Continued)

supply, storage, and pumping facilities for Heeling, Matteson, and Buffalo Grove, Illinois. Served as project manager for DynaGel turnkey wastewater treatment plant start-up and operational adjustments.

Supervised RCRA hazardous waste studies for United States Steel Corporation facilities located in Gary, Indiana, Chicago, Illinois, Provo, Utah and Pittsburg, California involving analysis of solid and hazardous waste generation rates, waste handling and disposal procedures, and possible operational changes which could be made to diminish the impact of the RCRA regulations. Completed monitoring well plans and studies at the Pittsburg Works to comply with California hazardous waste requirements. Completed a turnkey contract at the Geneva and Gary Works to locate, install, sample, and analyze hazardous waste monitoring wells for the first year monitoring program, and prepared groundwater monitoring reports. Sampled and analyzed six hazardous waste streams at the Gary Works for possible delisting. Worked on Part B RCRA Permits for IBM and GE.

Biographical Data

H. DANIEL HARMAN, JR.

Hydrogeologist

PII Redacted

[redacted]

Education

B.S. in Geology, 1970, University of Tennessee

Professional Affiliations

Registered Professional Geologist (Georgia No. 569)
Certified Water Well Driller (National Water Well Association No. 2664)
Georgia Ground-Water Association

Experience Record

1975-1977	Northwest Florida Water Management District, Havana, Florida. Hydrogeologist. Responsible for borehole geophysical logger operation and log interpretation. Reviewed permit applications for new water wells.
1977-1978	Dixie Well Boring Company, Inc., LaGrange, Georgia. Hydrogeologist/Well Driller. Responsible for borehole geophysical logger operation and log interpretation. Conducted earth resistivity surveys in Georgia and Alabama Piedmont Provinces for locations of water-bearing fractures. Drilled with mud and air rotary drilling rigs as well as bucket auger rigs.
1978-1980	Law Engineering Testing Company, Inc., Marietta, Georgia. Hydrogeologist. Responsible for groundwater resource evaluations and hydrogeological field operations for government and industrial clients. Served as project hydrologist during the installation of both fresh and saline water wells at the Mississippi Field regional aquifer to evaluate feasibility of storing high-level radioactive waste in the Gulf Coast Salt Domes.
1980-1982	Ecology and Environment, Inc., Decatur, Georgia. Hydrogeologist. Responsible for project management of hydrogeological and geophysical investigations at uncontrolled hazardous waste sites. Prepared Emergency Action Plans and Remedial Approach Plans for EPA. Prepared hazardous waste ranking of Superfund

H. Daniel Harman, Jr. (Continued)

listed sites in the southeast using the MITRE hazardous ranking system.

1982-1983 NUS Corporation, Tucker, Georgia. Hydrogeologist. Responsible for project management of hydrogeological and geophysical investigations at uncontrolled hazardous waste sites.

1983-Date Engineering-Science. Hydrogeologist. Responsible for hydrogeological and geophysical evaluations at hazardous waste sites.

Publications

"Geophysical Well Logging: An Aid in Georgia Ground-Water Projects," The Georgia Operator, 1977 (Coauthor D. A. Watson).

"Application of Geophysical Techniques as a Site Screening Procedure at Hazardous Waste Sites," Proceedings of the Third National Symposion and Exposition on Aquifer Restoration and Ground-Water Monitoring, Columbus, Ohio, 1983 (Coauthor S. Hitchcock).

Papers and Presentations

"Use of Surface Geophysical Methods Prior to Monitor Well Drilling," presented to Fifth Southeastern Ground-Water Conference, Americus, Georgia, 1981.

"Cost-Effective Preliminary Leachate Monitoring at an Uncontrolled Hazardous Waste Site," presented to the Third National Conference on Management of Uncontrolled Hazardous Waste Sites, Washington, D.C., 1982 (Coauthor S. Hitchcock).

"Developing Ground-Water Supplies on the Georgia Piedmont: Applied Technology Versus the "Dry Hole" Syndrome," presented at the Water Resources of Georgia and Adjacent Areas Conference, Atlanta, Georgia, 1983 (Coauthors D. Watson and T. Duffey).

"Georgia's Piedmont Ground-Water: Proper Well Location is Crucial to Effective Management," presented at the National Water Well Association Eastern Regional Conference on Ground Water Management, Orlando, Florida, 1983 (Coauthors D. Watson and T. Duffey).

Biographical Data

BARRY E. NORTH, Ph.D.

Chemist/Public Health Specialist

PII Redacted

[redacted]

Education

B.A. in Chemistry, 1966, The Johns Hopkins University, Baltimore, Maryland

Ph.D. in Organic Chemistry, 1971, Brandeis University, Waltham, Massachusetts

M.P.H. in Environmental Sciences, 1980, Columbia University, School of Public Health, New York

Professional Affiliations

American Association for Advancement of Science
American Chemical Society
American Industrial Hygiene Association, Rocky Mountain Section
American Public Health Association

Experience Record

1971-1972 Technion-Israel Institute of Technology. Postdoctoral Research Fellow. Conducted research in organometallic chemistry.

1972-1973 Oceanics School. Instructor. Taught mathematics and navigation.

1973-1974 Boston University College of Basic Studies. Instructor. Taught courses in the physical sciences.

1974-1976 Boston University School of Medicine (Biophysics). Research Associate. Investigated lipids associated with atherosclerosis.

1977-1978 Brookhaven National Laboratory, Biology Department. Senior Research Associate. Investigated toxicological effects of methylene chloride and interaction with hemoglobin.

1979-1982 Fred C. Hart Associates, Inc., Consultants. Senior Scientist. Responsible for technical input to hazardous waste investigations.

Barry E. North, Ph.D. (Continued)

Director, High Hazard Laboratory. Responsible for setting up and operating prototypical laboratory for screening hazardous waste samples under contract to EPA. Acted as corporate health and safety director.

Manager, Hazard Analysis Activities. Responsible for developing hazard analyses for chemicals for all corporate projects.

1983-Date Engineering-Science. Public Health/Hazardous Waste Specialist. Developed a hazard analysis plan and provided other technical input for an environmental impacts review of a proposed oil shale operation in western Colorado under contract with EPA Region VIII. Investigated various options for treating the hazardous wastes and developed a remedial action plan for cleanup of abandoned process water ponds contaminated with polynuclear aromatic hydrocarbons.

Publications

"Photochemical Synthesis of Cyclobutadiene (cyclopentadienyl)-Cobalt," Journal of the American Chemical Society, 1968 (Coauthor M. Rosenblum).

"Reaction of 1,3,5-cycloheptatriene with Dicarbonyl (pentane-2,4-dionato) Rhodium," Journal of Organometallic Chemistry, 1970 (Coauthor M. Rosenblum).

"Fluxional Behavioral of a Dicobalt Complex. An Example of Metal-carbon $\sigma - \pi$ Interconversion," Journal of Organometallic Chemistry, 1971 (Coauthors M. Rosenblum, W. P. Giering, and D. Wells).

"Synthesis and Chemistry of h^4-cyclobutadiene (h^5-cyclopendadienyl)-cobalt," Journal of the American Chemical Society, 1972 (Coauthors M. Rosenblum, D. Wells, and W. P. Giering).

"The Synthesis of (4.4.3) Propellanes Containing One Cyclohexadiene Ring," Tetrahedron, 1972 (Coauthors C. Amith, J. Kalo, and D. Ginsburg).

"The Thermal Transitions and Structural Properties of 5α-cholestan-3β-ol Esters of Aliphatic Acids," Biochimica et Biophysica Acta, 1976 (Coauthors G. G. Shipley and D. M. Small).

"Thermal Transitions and Structural Properties of Cholestanyl and Binary Mixtures of Cholestanyl and Cholesteryl Esters," Biophysical Journal, 1976 (Coauthors G. G. Shipley and D. M. Small).

Barry E. North, Ph.D. (Continued)

"Crystal and Liquid Crystal Transitions of Cholestanyl Esters and Binary Mixtures of Cholestanyl and Cholesteryl Esters," Abstracts: 6th International Liquid Crystal Conference, 1976 (Coauthors G. G. Shipley, and D. M. Small).

"Thermal and Structural Properties of Cholestanyl Myristate-Cholesteryl Myristate and Cholestanyl Myristate - Cholesteryl Oleate Binary Systems," Journal of Physical Chemistry, 1977 (Coauthor D. M. Small).

"Neutron Diffraction of Cholesteryl Myristate in Different Physical States," Biophysical Journal, 1977 (Coauthors G. G. Shipley, D. M. Small, D. M. Engleman, and B. P. Schoenborn).

"The Dissolution of Cholesterol Monohydrate Crystals in Atherosclerotic Plaque Lipids, Antherosclerosis, 1978 (Coauthors S. S. Katz, and D. M. Small).

"Dichloromethane as an Antisickling Agent in Sickle Cell Hemoglobin," Biochemical and Clinical Aspects of Hemoglobin Abnormalities, 1978 (Coauthor B. P. Schoenborn).

"Weak Binding Gases as Modulators of Hemoglobin Function," Molecular Basis of Mutant Hemoglobin Dysfunction, 1980 (Coauthors B. P. Schoenborn and A. Saxena).

"Use of a Regulated Access Laboratory for Screening and Preparation of Hazardous Waste Site Samples," Proceedings of the 2nd Conference on Management of Uncontrolled Hazardous Waste Sites, 1981 (Coauthors K. H. Driscoll and L. W. Stratten).

Biographical Data

ROBERT S. McLEOD, P.E.

Hydrologist

PII Redacted

[redacted]

Education:

B.S., Civil Engineering, University of Illinois, 1962
M.S., Civil Engineering, University of Wisconsin, 1965

Professional Affiliations

Registered Professional Engineer, Georgia
American Society of Civil Engineers
American Water Resources Association
National Water Well Association

Experience Record

1962-1964 U.S. Army Corps of Engineers. Staff Engineer on a low-head dam rehabilitation project. Staff Engineer Responsible for monitoring dredging operations for turning basins in small harbors.

1964-1980 U.S. Geological Survey. Project Chief for a study to evaluate the effects of using ground water to maintain lake levels. The relationship between various hydrologic factors and water-level fluctuations and the response of the hydrologic system to pumping ground water into the lake was described.

Project Chief for a study to analyze an aquifer system using three-dimensional digital-modeling techniques and to determine probable future effects that ground-water pumping would have on the system. Head declines in the water table and underlying deep aquifer and reductions in flow of nearby streams were predicted under proposed development plans.

Project Chief for a study to develop a digital-computer program that could be used to solve two-dimensional, confined ground-water flow problems and to use the program to predict changes in flow caused by pumping.

Project Chief for studies to create automated data files for storing various types of hydrologic records and to develop support programs for displaying the data.

ROBERT S. McLEOD, P.E. (Continued)

Project Chief for a study to evaluate the impact of construction of a reservoir and a floodwater-retention structure on the hydrologic system in a small basin. The ground water and surface water hydrology were defined and hydrological changes caused by construction were identified.

Project Hydrologist for a study to investigate surface and ground water availability in an area of near-surface crystalline rock. The availability of ground water as a source of industrial and municipal supplies was identified for several communities.

Project Hydrologist for a study to refine flood-frequency relationships for streams so that flood frequencies for at least a 50-year flood could be determined.

Project Hydrologist for a study to provide information on the magnitude and frequency of low flows from streams and to understand the relationship between low-flow characteristics and basin characteristics.

Project Hydrologist for basic records collection of surface water and ground-water data. Surface water data were collected to aid in defining the statistical properties of, and trends in, the occurrence of water in streams and lakes. Ground-water data were collected on water-level fluctuations in principal aquifers to monitor natural and man-induced changes and to estimate the severity of climatic cycles on the availability of ground water.

1980-1982 Law Engineering Testing Company, Atlanta, Georgia. Project Manager for coal hydrology studies in Alabama as part of the Office of Surface Mining Small Operator Assistance Program (SOAP). These studies entailed geologic and hydrologic analyses of mining sites to describe the geology of the site and to estimate the probable hydrologic consequences of mining.

Director of Analysis and Reporting and hydrogeologist for a $25 million project to investigate the feasibility of using salt domes in the Gulf Coast area for the storage of high-level nuclear wastes. The geology and hydrology in the vicinity of selected domes were defined. Ground-water flow around the domes was defined and directions and rates for contaminant transport were identified.

ROBERT S. McLEOD, P.E. (Continued)

1982-Date Engineering-Science, Inc., Atlanta, Georgia. Responsible for ground-water monitoring studies,(pump) aquifer testing, contaminant migration studies and modeling of ground-water systems.

Publications

McLeod, R. S., 1973, Ground-Water Occurrence and Movement Related to Aquifer System Models: in Workshop Proceedings, Indiana Water Resources - Future Problems and Needs, Purdue University, May 10-11, 1973.

McLeod, R. S., 1975, A digital-computer model for estimating drawdowns in the sandstone aquifer system in Dane County, Wisconsin; Wisconsin Geological and Natural History Survey Information Circ. 28, 91 p.

McLeod, R. S., 1975, A digital-computer model for estimating hydrologic changes in the aquifer system in Dane County, Wisconsin: Wisconsin Geological and Natural History Information circ. 30, 40 p.

McLeod, R. S., 1978, Water level declines in the Madison area, Dane County, Wisconsin: U.S. Geological Survey open file report, 15 p.

McLeod, R. S., 1980, The effects of using ground water to maintain water levels of Cedar Lake, Wisconsin: U.S. Geological Survey Water Resources Investigation 80-23, 35 p.

Papers and Presentations

"Ground Water Flow in the vicinity of Richton and Cypress Creek Salt Domes, Perry County, Mississippi," presented at the Fifth Southeastern Ground Water Conference, November 1981.

"Water Use Data Collection Program in Wisconsin," presented at the Midwest Ground Water Conference, November 1979.

"Ground-Water Modeling Techniques for Managing Aquifer Systems," presented at the University of Wisconsin continuing education Sanitary Engineering Institute, March 1979.

"Relation Between Ground Water Pumping and Streamflow in the Yahara River Watershed, Wisconsin," presented at the Madison Hydrology Club, November 1978.

"A Digital Computer Model for Estimating Hydrologic Changes in the Aquifer System Underlying Dane County, Wisconsin," presented at the American Water Resources Association Tenth National Convention, August 1974.

ROBERT S. McLEOD, P.E. (Continued)

"A Digital Computer Model for Estimating Drawdowns in the Sandstone Aquifer, Madison, Wisconsin," presented at the National Water Well Association Midwest Conference, September 1973.

"Ground Water Occurrence and Movement Related to Aquifer System Models" presented at the Purdue University Water Resources Workshop, May 1973.

Biographical Data

ROGER S. CARLOS

Civil Engineer

PII Redacted [redacted]

Education

B.S. in Civil Engineering, 1964, Manuel Quezon University, Manila, Republic of the Philippines

Professional Affiliations

Registered Professional Engineer (Illinois No. 62-31857)

Experience Record

1965-1970 Heights Construction Inc., Quezon City, Republic of the Philippines. Project Engineer. Responsible for supervising the construction of reservoirs, pump stations, and water mains. Work included survey and layout of numerous subdivision projects. Participated in concrete and steel design, quantity takeoffs, and drafting.

1970-1972 Bongi Cartage, Inc., Cicero, Illinois. Project Engineer. In charge of all field engineering surveys, quantities, and progress reports. Assisted in the coordination of projects.

1972-1973 Metropolitan Sanitary District of Greater Chicago, Chicago, Illinois. Assistant Resident Engineer. Responsible for checking and inspection of work incorporated in projects. Also responsible for preparation of all progress reports.

1973-1977 Reliance Underground Construction, Elk Grove Village, Illinois. Assistant Chief Engineer. Responsible for estimating and preparing bids for $2.5 million Upper Des Plaines Intercepting Sewer project of the Metropolitan Sanitary District of Greater Chicago. Assisted in bid preparation for other Chicago sewer projects, including the Foster Avenue and the Beverly-Calumet auxiliary sewers. Responsible for all field engineering and preparation of project CPM's and schedules.

Roger S. Carlos (Continued)

1977-Date Engineering-Science. Construction Engineer. Served as resident engineer for the Northwest Regional Sewer Area Project in Lake County, Illinois, a $14 million sanitary sewer collection and conveyance system comprised of 30 miles of sewers, three major pump stations, and 14 lift stations with appurtenances. Participated in field investigation and reviewed shop drawings and construction procedures for mainstream tunnel collecting structure for the Metropolitan Sanitary District of Greater Chicago's Tunnel and Reservoir Plan. Served as resident engineer during construction of a pump station and 2-mg reservoir at Buffalo Grove, Illinois.

Biographical Data

ROSSLYN W. WEMYSS

Civil Engineering Designer

PII Redacted

[redacted]

Education

Civil Engineering and Computer Technology, Pasadena City College, California

Languages

Spanish, Italian, and French

Experience Record

1960-1961	International Mapping Company. Drafter. Responsible for drafting topographic and street maps.
1961-1964	Wilsey, Ham and Blair. Drafter. Performed general civil drafting including plans for streets, sewers, storm drains, and grading and related surveying office work.
1965-1966	Richard S. Angvire, Civil Engineer. Drafter. Performed general civil drafting and related surveying computations. Also prepared sewer and storm drain geometric designs for subdivisions.
1966-1970	Veco, Inc. Drafting Supervisor. Supervised preparation of plans showing underground facilities of the Southern California Edison Company. Other duties included estimate of man-hours, distribution of work, checking, and billing.
1970-1973	Willdan Associates. Engineering Design Draftsman. Responsible for drafting from field notes to final geometric design of sewers and storm drain. Prepared street improvement and grading plans, earthwork computations, and quantity estimates. Checked tract and parcel maps for closure and minimum area requirements of the total property, blocks, and each individual lot of subdivisions. Also responsible for checking against existing legal documents, deeds, recorded maps, and legal descriptions of dedications to the city.

Rosslyn W. Wemyss (Continued)

1973-1974 E.C.D., Inc. Engineering Designer. Responsible for preparation of civil drawings related to subdivisions, condominiums, and apartment developments. Performed grading, sewer, storm drain, streets, earthwork, and surveying computations. Prepared land division maps and performed related investigation and research of recorded data at city, county, and state agencies.

1974-Date Engineering-Science. Civil Engineering Design Drafter (1974-1978). Responsible for preparation of plans and details for landfill gas venting systems and conduct of corresponding field work including supervision of boring, placing, and monitoring of probes. Developed plans for grading and drainage of sedimentation ponds, prepared piping layout, and performed earthwork computations for sewer design. Correlated civil design for storm drain projects including revising grades. Prepared piping layouts and isometric schematics of chemical piping and site improvement details for water treatment plant expansions. Performed flood control and drainage channel final alignment design and earthwork computations in Spanish.

Senior Civil Engineering Designer (1979-Date). Responsible for civil design and plan preparation on projects involving hazardous waste facility design, landfill gas control, water and wastewater treatment, flood control and drainage, potable water distribution, and nonhazardous waste disposal. Projects include design of flood control and drainage channels for Chimbote, Peru, and Port-au-Prince, Haiti. Supervised well drilling, pipe installation, and installation and monitoring of methane gas probes, and inspected gas migration barriers for numerous landfill gas venting systems. Developed preliminary designs for hazardous and nonhazardous waste disposal facilities and performed engineering constraint matrix evaluation of alternative spent shale disposal sites for TOSCO. Designed a major storm drain for El Segundo and directed design of the Cerritos reclaimed water distribution system, which called for 120,000 ft of 4-in to 24-in diameter pipeline.

Biographical Data

ROBERT W. ADAM

Sanitary Engineer

PII Redacted

[redacted]

Education

A.A.S. in Ecology and Environmental Technology (high honors), 1979, Paul Smith's College of Arts and Sciences

B.S. in Agricultural and Biological Engineering, 1981, Cornell University

M.S. in Sanitary Engineering, 1983, Virginia Polytechnic Institute and State University

Professional Affiliations

Water Pollution Control Federation

Experience Record

1980-1981 Cornell University, Ithaca, New York. Research Technician. Responsible for sample collection, land application of chemicals and animal waste, installation of irrigation systems and water monitoring equipment, and laboratory analyses for research on nonhomogeneous nutrient movement through nonhomogeneous soils. Constructed surface and subsurface collection systems and evaluated field monitoring sites for a project on pollutant analysis of surface and subsurface runoff from small-scale dairy farm barnyards. Responsible for statistical analysis and data monitoring and collection to determine the impact of nonpoint source pollution at a dairy farm.

1981-1983 Virginia Polytechnic Institute and State University, Blacksburg, Virginia. Graduate Research Assistant. Responsible for waste sludge thickening and dewatering experiments, design and operation of a laboratory-scale activated sludge treatment system, and collection and computer analysis of laboratory and full-scale activated sludge treatment system operational data for an EPA research grant project on the effect of operational parameters on the thickening and dewatering characteristics of waste domestic sludge.

Robert W. Adam (Continued)

1983-Date Engineering-Science. Sanitary Engineer. Responsible for material and cost estima:es, engineering calculations, and specifications review for wastewater treatment plant design projects. Prepared hydraulic design calculations, preliminary plan drawings, and construction, instrumentation, equipment and material quantity takeoff from civil and structural drawings for design of a wastewater reclamation facility.

Biographical Data

JAMES N. BAKER

Environmental Scientist

PII Redacted [redacted]

Education

Advanced Wastewater and Water Treatment Operations, 1978, Rutgers University, New Brunswick, New Jersey

B.S. in Geology, 1983, Georgia State University, Atlanta

Experience Record

1977-Date Engineering-Science. Field Technician (1977-1979). Responsible for in-plant surveys and bench and pilot-scale treatability testing. Projects included evaluations of herbicide waste treatment, studies of phosphorus removal for an inorganic chemicals plant, and operations assistance and facilities upgrading for a pharmaceutical wastewater treatment plant. Conducted biotreatability and inhibition/degradation assays for coffee production wastestreams and wastewater characterization and evaluations of treatment alternatives at organic chemicals, plastics, and textile manufacturing facilities. Also involved in pilot operations to purify contaminated groundwater after a gasoline spill.

Technical Specialist (1980). Responsible for planning and conducting field engineering activities for various industrial waste studies, including plastics production wastewater, organic chemical plant waste, and pulp and paper mill wastewater. Activities included experimental planning; laboratory and pilot-scale treatment process operation; data collection, evaluation, and quality assurance; troubleshooting; facility start-up; operator training; and report preparation. Projects included operations evaluation and assistance programs at industrial and municipal wastewater treatment plants ranging from 0.1-mgd to 70-mgd capacity. Conducted wastewater characterization study of a plastics production facility, including development of sampling program, priority pollutant sampling, and location of flow sources using dye tracers. Responsible for start-up of 10-mgd activated sludge wastewater treatment facility for the city of Columbus, Mississippi, including equipment evaluation and

James N. Baker (Continued)

personnel training in operation, sampling, and analysis.

Environmental Scientist (1981-Date). Evaluated waste solids handling at a textile chemical production facility, including a 0.5-mg sludge holding pond, 2-mg aerobic digester, and 70 acres of sludge spraying fields. Conducted pilot-scale aerobic digestion study, performed an odor reduction evaluation, and developed operating strategy for the solids handling facility. Performed wastewater characterization and pretreatment evaluation for a battery production facility, and evaluated primary and secondary waste activated sludge dewatering at a chemical dyes plant. Performed laboratory and bench-scale treatability study for solvent removal from contaminated groundwater by solvent stripping and adsorption/absorption techniques. Participated in groundwater monitoring program at a pulp and paper mill, with responsibility for well development and priority pollutant sampling at nine monitoring locations around the plant site.

Served as project scientist for an activated sludge treatability study to determine the impact of starch and polyester resin size material on existing waste treatment system at a blended fabrics plant. Conducted waste stream characterization and biological treatability studies for preliminary design of an organics treatment facility. Operated four bench-scale biological test reactors for evaluating the treatment of suspended solids, organics, pesticides, and arsenic. Conducted a wastewater characterization for removal of oil and grease at a rubber and plastic finishing plant. Evaluated market potential and technical feasibility of a potential new inorganic chemical product for use in water and wastewater treatment. Tested the effectiveness of organics removal at an activated sludge plant treating groundwater, separator wastes, and process wastes. Tested organic removal capability of a biological treatment system at a beverage concentrate plant. Evaluated land application alternatives for disposal of anaerobically digested sludge. Conducted jar tests for removal of silt-size silicon particles from a glass grinding operation.

Project Geologist (1983-Date). Responsible for hydrogeologic field investigations at a hazardous waste site in Illinois involving surficial soil sampling, surface water and sediment sampling, stream flow measurements, well installation and sampling,

James N. Baker (Continued)

geophysical surveys using electrical resistivity, direct measurement of groundwater flow direction and velocity, and mapping surface water, sediment, surface soil, and groundwater contamination. Performed a hydrogeologic investigation at an Army landfill, including direct measurement of groundwater flow direction and velocity, groundwater sampling, and mapping of surface drainage patterns. Conducted a geophysical survey using a magnetometer and installed a gas monitoring well for a gas migration investigation at an abandoned municipal landfill.

Biographical Data

DUANE R. BOLINE

Analytical Chemist

PII Redacted [redacted]

Education

B.S.E., Physical Science, Emporia State University, 1962
M.S., Chemistry, Emporia State University 1965
Ph.D., Analytical Chemistry, Kansas State University, 1975

Professional Affiliations

American Chemical Society
Society for Applied Spectroscopy

Awards, Honors, Scholarships

Emporia State University Endowment Association Academic Scholarship
Emporia State University Athletic Scholarship
National Science Foundation Fellowship
Lamba Delta Lamba Honorary Physical Science Fraternity

Experience Record

1962-1968 Kansas Public Schools, Science Teacher and Basketball Coach

1968-1980 Assistant Professor; Associate Professor of Chemistry. Taught undergraduate and graduate analytical chemistry courses in addition to maintaining an active Master's Degree research group. Major research interests were trace metal analysis by atomic absorption spectroscopy, the enhancement of sensitivity obtained in flame atomic absorption by the use of organic solvents, and environmental chemistry.

This work included an investigation of the trace metal content of metalloenzymes separated by liquid chromatography by use of graphite furnace atomic absorption spectroscopy. The activity of the purified enzymes was investigated after removal or complexation of the metal and compared to the activity of the normal enzyme.

Served as an Associate Referee for the Association of Official Analytical Chemists for the methods of determination of copper, zinc and cobalt in plants (1975-1980).

Duane R. Boline (Continued)

Provided extensive consulting and chemical analysis services to industries in Eastern Kansas. This work included determinations of wastewater quality and chemical analysis of products and by-products for QA purposes.

Participated in projects which required analysis for inorganic and organic pollutants in fresh water streams and lakes for the U.S. Army Corps of Engineers. This included work on environmental impact studies and water quality studies of reservoirs in Southern Kansas. In addition to teaching the traditional courses in undergraduate general and analytical chemistry, a series of laboratory-oriented, one-hour credit, graduate level courses entitled 'Topics in Analytical Chemistry' was developed. This was a series of self-contained courses in Ultraviolet and Visible Spectroscopy, Infrared Spectroscopy, Nuclear Magnetic Resonance Spectroscopy, Atomic Absorption Spectroscopy, Flame Photometry, Gas Chromatography, High Performance Liquid Chromatography, Potentiometry, and Polarography.

Served as faculty advisor to the student American Chemical Society affiliate, and received a special student-originated award as the Outstanding Chemistry Professor in 1976.

Invited to work as a temporary research chemist for the National Institute of Environmental Health Science. Prepared a summary document of the literature pertaining to the speciation and mechanisms of trace metals in biological systems. A review of analytical techniques for the determination of trace elements in mammals was prepared and several areas of proposed research were outlined.

1980-1984 Radian Corporation, Austin, Texas. Staff Scientist (1980-1981). Co-Project Director for National Toxicology Program Chemical Repositories. Served as chemical analysis task leader and project manager for Hazardous Materials Laboratory Operations.

Senior Scientist (1981). Group Leader of the Inorganic Analysis Group. Had responsibility for the technical and personnel management of the Atomic Spectroscopy and water quality laboratories which provided analytical support for synfuels/coal gasification, environmental, and hazardous waste assessment projects.

Duane R. Boline (Continued)

Director of Analytical Services (1982-1984). Responsible for management of one of four profit centers within the company. Provided the marketing, technical, financial and personnel management for the Analytical Services Laboratories as located in Austin, Texas and Sacramento, California. The Analytical Services Laboratories provided chemical analysis for commercial and governmental clients.

Provided analytical support and technical consultation to clients in the chemical, petrochemical, wood and paper, electronics, synfuels, and other related fields.

These laboratories offered a full range of chemical analysis capabilities including: Atomic Absorption Spectroscopy, Inductively Coupled Plasma Emission Spectroscopy, Gas Chromatography, Mass Spectroscopy, and conventional wet chemical analyses, and featured a computerized laboratory management system.

Had responsibility for proposal preparation and project management for RCRA, NPDES, and other related projects. Obtained EPA Contract Laboratory Program projects for both organic and inorganic chemical analysis.

1984-Date — Engineering-Science, Atlanta, Georgia. Director of Laboratory Services. Management of chemical analysis laboratory providing support to engineering-services. Major projects require analysis of samples from hazardous waste sites involved in remedial action assessment. In addition to laboratory management, technical support is provided to the engineering staff for proposal and report preparation.

Management Training Courses and Seminars

Group Leader Training Course - Radian Corporation

Project Director Training Course - Radian Corporation

Program Management Training Course - Radian Corporation

Laboratory Management Seminar - McGraw-Hill Corporation, Oscar Milnar, Leader

Laboratory Manager Training Course - Radian Corporation, prepared and presented by Duane R. Boline

Duane R. Boline (Continued)

Publications/Reports

Boline, Duane R., L. H. Keith and D. B. Walters, "Management of a Chemical Repository for Chemicals Used in Coded Toxicity Testing," Chapter 17, pp. 213 - 220 in Chemistry For Toxicity Testing, C. W. Jameson, D. B. Walters, editors, Butterworth Publishers, 1983.

Boline, Duane R., L. H. Keith, and D. B. Walters, "Inventory Management and Data Storage for Chemicals Used in Coded Toxicity Testing," American Chemical Society Meeting, Las Vegas, NV, 1982.

Boline, Duane R., L. H. Keith, and D. B. Walters, "A Computerized Data Management System for a Hazardous Materials Laboratory," American Chemical Society Meeting, New York, NY, 1981.

Boline, Duane R., "Some Speciation and Mechanistic Aspects of Trace Metals in Biological Systems," Chapter 44 in Environmental Health Chemistry--Chemistry of Environmental Agents as Potential Hazards, James McKinney, editor, Ann Arbor Press, Ann Arbor, MI, 1980.

Boline, Duane R. and W. G. Schrenk, "Atomic Absorption Spectroscopy of Copper and Iron in Plant Material," J.A.O.A.C., 60, 1170-1174, 1977.

Boline, Duane R. and W. G. Schrenk, "A Method for Determination of Cadmium in Plant Materials by Atomic Absorption Spectroscopy," J. Appl. Spectros., 30, 607-610, 1976.

Daub, Robert and Duane R. Boline, "A Comparison of the Growth Rate and Chlorophyll Production of Egulena Gradilis as a Function of Copper Content in the Organism," Kansas Academy of Science Meeting, Fort Hays, KS, 1980.

Parli, Joseph and Duane R. Boline, "A Method for the Determination of Boron by Electrically Heated Tantalum Ribbon Atomic Absorption Spectroscopy," Midwest Regional American Chemical Society Meeting, St. Louis, MO, 1979.

Hiebert, Greg and Duane R. Boline, "A Comparison of the Sensitivity Obtained for the Determination of Copper by Atomic Absorption Spectroscopy, as a Function of Physical Properties of Non-Aqueous Solvents, "Kansas Academy of Science, Wichita, KS, 1979.

Parli, Joseph and Duane R. Boline, "A Method for the Determination of Copper in Plant Material by Atomic Absorption of Spectroscopy Using an Acidic Methanol Solvent," Midwest Regional American Chemical Society Meeting, Fayettville, AR, 1978.

Duane R. Boline (Continued)

Boline, Duane R. and W. G. Schrenk, "A Method for the Determination of Copper and Iron in Plant Material by Atomic Absorption Spectroscopy," National AOAC Meeting, Washington, DC (1976) and Rocky Mountain Conference on Applied Spectroscopy, Denver, CO, 1975.

Boline, Duane R. and W. G. Schrenk, "A Method for the Determination of Cadmium by Atomic Absorption Spectroscopy," Rocky Mountain Conference on Applied Spectroscopy, Denver, CO, 1974.

Biographical Data

PATTI L. KAYE

Civil Engineer

[redacted]

Education

B.S. in Civil Engineering (Environmental Option), 1984, California State Polytechnic University, Pomona

Professional Affiliations

Registered Engineer-in-Training (License No. 060625)
American Society of Civil Engineers

Experience Record

1983	Jurupa Community Services District, Riverside, California. Engineering Aid. Organized and performed field work for District valve manual; plan checking; and special projects.
1984	Los Angeles County Sanitation Districts, Whittier, California. Junior Engineer. Conducted a survey of companies responding to new EPA Categorical Pretreatment Standards for industrial discharges.
1984-Date	Engineering-Science. Assistant Engineer. Responsible for field sampling supervisor, engineering studies, and design in support of municipal water and wastewater, industrial wastewater, and hazardous waste management projects. Specific assignments include field sampling activities during clean-up of hazardous waste sites at Edwards Air Force Base, California; design support for industrial wastewater treatment system improvements at Hughes Aircraft Electronics Division plant in El Segundo, California; and support studies for design of water distribution system expansion for Norco, California; and wastewater treatment plant expansion for Palm Desert, California.

APPENDIX B

GLOSSARY

APPENDIX B

GLOSSARY AND ACRONYMS

AFESC - Air Force Engineering And Services Center

AFFTC - Air Force Flight Test Center

AFRPL - Air Force Rocket Propulsion Laboratory

ARB - California Air Resources Board

Biological Denitrification - The reduction of nitrate to gaseous nitrogen brought about by denitrifying bacteria

CATEX 2Y - Categorical Exclusion (Air Force Regulation 19-2)

Class I Disposal Site - A fully permitted hazardous waste disposal site in California

DHS - Department of Health Services

DOT - Department of Transportation

DPDO - Defense Properties Disposal Office

EPA - Environmental Protection Agency

Hazardous Potential Levels

- A - Full facepiece, positive pressure demand air-supplied breathing apparatus, NIOSH or OSHA standards, total skin protection by impervious outer garment, boots, gloves
- B - Full facepiece, positive pressure demand air-supplied breathing apparatus, NIOSH or OSHA standards. Impervious overalls, boots, gloves
- C - Full facepiece air-purifying respirator, impervious apron, coveralls, boots, gloves
- D - Carry the air-purifying respirator specified in Level C, coveralls, boots and gloves

HNU - Detector - Portable trace gas analyzer with photoionization detector

IRP - Installation Restoration Program

LC_{50} - Lethal concentration 50. The concentration of a substance which is fatal to 50 percent of the test population over a given period of time.

LD_{50} - Lethal dose 50. The dose of a substance which is fatal to 50 percent of test population over a given period of time.

Lysimeter - An instrument for collecting the water percolating through soils.

NASS - National Accident Safety System

NO_3 - Nitrate nitrogen

O&M - Operation and maintenance (used in reference to life cycle costs)

OVA - Organic Vapor Analyzer -- a device used to monitor air for the presence of organic vapors

pH - A term used to describe the hydrogen-ion activity of a system. A solution of pH 0 to 7 is acid, pH of 7 is neutral, and pH over 7 to 14 is alkaline.

Pieziometric Level - The water level in an aquifer under unconfined conditions

Playa - A low, flat part of a basin or other undrained area in an arid region where fine-grained material, such as clay, is deposited.

POL - Petroleum, oils, and lubricants

RAP - Remedial Action Plan

RCRA - Resource Conservation and Recovery Act

Recommended Remedial Action - A combination of remedial action technologies which will clean up or mitigate site-specific contamination problems.

RWQCB - Regional Water Quality Control Board

SWRCB - State Water Resources Control Board

TLV - Threshold Limit Value -- the limit of an acceptable concentration for exposure over set time period (8 hours, 24 hours, etc.)

TOC - Total Organic Carbon

TSD - Treatment, storage, or disposal facility

APPENDIX C

CONTRACT WASTE DISPOSAL SITES

TABLE C-1

CLASS I DISPOSAL SITES
ECONOMIC COMPARISON[1]

Site Location	Owner	Types of Waste Accepted	Approx. Haul Distance (miles)	Haul Cost	Disposal Cost
Martinez	IT Environmental Corporation 415/228-5100	Limited liquids and sludges, acids, bases, solvents, cyanides and phenols, no pesticides or herbicides, no chlorinated solvents in bulk, liquid or drums	380	$9/drum	Disposal estimate requires profile sheet
Benicia	IT Environmental Corporation 415/228-5100	Liquids, sludges, acids, bases, pigment wastes, oil and water, heavy metals, contaminated soils, and pesticides, soils with chlorinated solvents. No PCBs, water reactive or radioactive wastes.	380	$9/drum $56/cy soil	$50/cy soil
Richmond	West Contra Costa County Landfill 415/236-8000	Excavated soil contaminated with hazardous waste, no barreled waste since March 1980. Accepts bulk liquids and sludges	380	No hauling of contaminated soils	$77/cy
Kettleman Hills	Chemical Waste Management, Inc. 209/935-2043	All hazardous wastes and contaminated soils in any form except radioactive and water reactive wastes	215	Liquid: $49/drum - haul and dispose Solidified: $32/drum - haul and dispose $33/cy soil	$50/cy soil
West Covina	BKK Corporation 213/539-7150	All hazardous wastes and contaminated soils in any form except explosives and radioactive wastes	150	$3/drum $20/cy soil	$24/drum (chlorinated compounds) $21/drum (nonflammable) $44/cy soil
Casmalia	Casmalia Resources 805/967-5897	Only solidified hazardous waste, drums or bulk, no explosives or radioactive materials. Accepts pesticide containers, nonliquid PCBs, sludges, solvents/cleaners, acids, bases, oils, cyanide and chromic acids.	275	$18/drum (haul and dispose of solidified waste) No hauling of contaminated soils	$60-84/cy soil
Beatty, Nevada	U. S. Ecology Louisville, KY 800/626-5317	Accepts all hazardous waste except explosive or radioactive. Chlorinated hydrocarbons in solidfied form only. Possible acceptance of liquid barreled chlorinated compounds, October 1984.	220	$7/drum No hauling of contaminated soils	$16/drum solidified $30-35/drum liquid $57/cy soil

(1) Haul costs and disposal costs are approximate as obtained from phone conversations with each of the contract disposal facilities.

TABLE C-2

CLASS I DISPOSAL SITE DESCRIPTIONS

Site Location (California)	Liner System	Leachate Treatment and Collection System	Ground-water Monitoring	Additional Waste Treatment/Disposal	Landfill Life Expectancy	Receptors	Environmental Site Conditions	Permits*
Benicia	Natural clay soil liner, no synthetic liners			Neutralization chemical precipitation Solar evaporation land farming	30 years	No ground water present 5 miles from nearest waterway No aquifers in area	285-acre site surrounded by 2,200-acre barrier	Have Class I Permit RCRA Part B application has been filed, waiting return
Richmond	Natural clay liner Class I site surrounded by clay perimeter levee 8' thick 5' cover over landfill	No leachate recovery in landfill Leachate drains into liquid waste pond	Class I site shallow monitoring wells (10) Two deep monitoring wells >100' deep Monitoring of first aquifer	Solar evaporation ponds for liquids	5 years 100,000 cy soil capacity remaining	Saturated soil surrounding landfill 35' highest elevation of solids above saturated clay barrier	Located next to bay area 27-acre site within 300 acres of Class I area	Have Class I Permit RCRA Part B application submitted, waiting return Pond for Class I liquid wastes is presumably closed
Kettleman Hills	All burial cells, either double or triple-lined, containment for soils, daily cover and surface dressing but not compacted, little infiltration, open ponds - pesticides, herbicides RCRA liners in all landfills	No leachate recovery since not much rainfall Have check dams to keep rainfall within property	Yes Extensive chemical analysis of wastes disposed of at the site	Incineration of organics Land spreading practiced Waste fixation and separation	75 years	Not in flood plain or fault zone No surface water in area of site Good geographical area	Clean, well-operated site Rural location secluded from major urban areas or developing rural areas	Management and technical compliance very good No litigation or past problems, follow regulations very closely Recently requested ground water monitoring waiver to EPA - undergoing review by EPA - Part B application. Appear to be backlogged on paperwork
West Covina	A shale bedrock natural liner used, no synthetic liners for Class I sites, two hydraulic barriers contain leachate in site area, runoff from landfill site is diverted into landfill by graded areas	Leachate system consists of a 2,400' drain collection system under Class I landfill and a pumping system incorporating airlift pumps to return leachate to landfill extraction well collection for leachate. The leachate is not treated but returned to landfill.	Extensive ground water monitoring system		10-15 years variable	A few minor springs in site area, no surface water nearby	Urban location, poor geographical location, perched water problem presently exists	Resubmitting Part B application of RCRA after EPA rejection, presently upgrading site operation, monitoring to meet EPA hazardous waste criteria
Casmalia								
Beatty (Nevada)	Natural clay barrier - 100' depth, landfill is blended cement-sand in gravel 25 to 30' deep, site containment soil-clay	No leachate collection or treatment	20 ground water monitoring wells samples analyzed monthly, soils samples analyzed quarterly, reported to EPA and Nevada Regional		20 years with an annual increase in waste volume of 10%	No ground water or surface water reported in site area	Located in Amargosa Desert Low rainfall, high evaporation	Majority of waste accepted originates from midwest and west coast Disposal of hazardous wastes only, no treatment

*All sites have Class I Permit from State of California.

APPENDIX D

ENVIRONMENTAL IMPACT ANALYSIS DOCUMENTATION
(Prepared by AFFTC)

REQUEST FOR ENVIRONMENTAL IMPACT ANALYSIS

FOR ENVIRONMENTAL PLANNING USE ONLY

I — REQUEST

1. TO: *(Environmental Planning Function)* AFFTC/DEEV	2. FROM: *(Organization and Office Symbol)* AFFTC/DEEV	3. CONTROL NUMBER 840020
5. REQUESTOR *(Name, Office Symbol and Phone No.)* TERRY YONKERS, DEEV, 4730		4. ESTIMATED COMP DATE

6. TYPE OF ANALYSIS NEEDED

	CATEX DETERMINATION	X	PRELIMINARY ENVIRONMENTAL SURVEY		ENVIRONMENTAL ASSESSMENT		ENVIRONMENTAL IMPACT STATEMENT

7. TITLE OF PROPOSED ACTION

EDWARDS AFB IRP - Phase IV

II — PROPOSED ACTION AND ALTERNATIVES

8. PURPOSE OF AND NEED FOR ACTION *(Continued on 1 of 2 Sheets)*

The purpose of IRP Phase IV at Edwards AFB is threefold:

1) To implement remedial actions for the clean-up of past hazardous waste disposal sites.

2) To implement remedial actions for the restoration of hazardous waste disposal sites other than clean-up or waste removal/disposal (i.e., long term monitoring and flood deviation).

3) To develop a long-term monitoring plan to ensure that remedial actions implemented

9. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES (DOPAA) *(Continued on - 3 Sheets)*

The Edwards AFB IRP - Phase IV involves specific remedial actions for three past hazardous waste disposal sites; these include Sites 1, 2, and 5. Site 1 is composed of five subsites. Below is a description of each site/subsite and the remedial actions to restore each site. A number of alternatives to the proposed clean-up actions were considered and are discussed, in detail, in the IRP - Phase IV Remedial Action Plan for Edwards AFB. Criteria used to select the preferred alternative were those developed by HQ Air Force Engineering and Services Center in their Phase IV Management Guidance for the Installation Restoration Program. Most important were:

a. Technologic Feasibility/Effectiveness
b. Regulatory Compliance/Acceptability
c. Health and Safety
d. Cost
e. Environmental Impact

10. ORGANIZATIONAL APPROVAL *(Name and Grade of Commander)*	SIGNATURE	DATE

III — ENVIRONMENTAL PLANNING RESPONSE

11. RESPONSES ATTACHED

- [ ] Preliminary Environmental survey *(AF Form 814)* attached
- [ ] Proposed action qualified for Catex *(Appropriate Documentation attached)*
- [ ] Proposed action does not qualify for Catex, assessment required

12. REMARKS

This action has been assessed in accordance with AFR 19-2. The remedial actions to cleanup hazardous waste disposal Sites 1, 2, and 5 at Edwards AFB will result in no significant adverse environmental impacts and qualify for a Categorical Exclusion (Type 2-y). A CATEX is hereby assigned to this action. (See attached AF Form 814).

	SIGNATURE	DATE
13. ENVIRONMENTAL PLANNER CERTIFICATION *(Name and Grade)* TERRY YONKERS, GS-12	Terry Yonkers	26 Jun 8[illegible]
14. ENVIRONMENTAL PROTECTION COMMITTEE APPROVAL *(Name and Grade)* JOHN H. TAYLOR, Colonel, USAF AFFTC Vice Commander	John H. Taylor	29 Jun 8[illegible]

D-1

AF FORM 813 PREVIOUS EDITION IS OBSOLETE

#8 cont.
during Phase IV are effective.
Actions implemented under IRP - Phase IV are needed to clean up past hazardous waste disposal sites which have the potential to contaminate surface or groundwaters or present a potential health or safety hazard to the public.

The action is needed to remove toxics which could contaminate surface or ground waters or to prevent such toxics from reaching surface or ground waters.

#9 cont

(1) SITE 1

(a) SUBSITE 1A. Subsite A consists of a small, shallow trench of recent origin.

Thirteen 55 gallon oil/solvent drums were disposed of at this location; there is evidence of oil spillage on the surface. Low concentrations of chloroform and freon II were found in surface soil samples and samples taken at 63 feet. No groundwater contamination has been identified.

REMEDIAL ACTION

Remove scattered debris, rinse, and dispose in Class II landfill (drums were previously sampled and waste materials were turned in to DPDO for reutilization). Fill in trench, return site to grade. Install monitoring wells.

(b) SUBSITE 1B. This site consists of ninety-six 55 gallon drums, about 30 contain some type of liquid waste. The drums are located on wooden pallets on the playa surface. Analysis showed low concentrations of freon II and chloroform contamination down to 55 feet in soil. No groundwater contamination has resulted.

REMEDIAL ACTION

Sample drums to determine waste constituents. Recycle containers/contents when possible, otherwise steam clean containers, dispose of containers in a Class II landfill dispose of waste material and residue in a Class I landfill. Install monitoring wells.

(c) SUBSITE 1C. This site consists of three pits where nitric acid was disposed. Nitrate concentrations are high at the surface (i.e., 11,400 mg/kg); pH is low (i.e., 0.4). Nitrates are 965 mg/kg at 55 feet, pH is 6.8. No groundwater contamination has resulted.

REMEDIAL ACTION

Install a synthetic liner and clay cap over each pit. Install monitoring/intercept wells.

(d) SUBSITE 1D. This site consists of two large trenches, each 100 feet long, 20 feet wide, and 10 feet deep. Approximately 1500 drums have been disposed in these trenches. Analytical results show low concentrations of freon II, chloroform, carbon tetrachloride, and several other hologenated organics down to 60 feet in soil. No groundwater contamination has resulted.

REMEDIAL ACTION

Remove drums and sample to determine waste constituents. Steam clean drums and dispose of drums in a Class II landfill on base. Dispose of residuals in a Class I landfill off base. Install a synthetic liner and impermeable clay cap. Install monitoring wells.

(e) SUBSITE 1E. This site consists of a small shollow trench where some empty containers and metal debris has been disposed.

REMEDIAL ACTION

Remove empty containers and metal debris and dispose in a Class II landfill. Fill in trench and return site to grade.

(2) SITE 2

Site 2 consists of a number of small, shallow trenches where plating wastes, fuel, and metal debris have been disposed. Analytical results show low levels of chromium and lead in the soil. Bedrock is at 20 feet; no aquifer exists at this site.

REMEDIAL ACTION

Install monitoring/intercept wells/lysimeters down gradient of the site.

(3) SITE 5

Site 5 consists of five, 50,000 gallon underground tanks used in the past for aviation gasoline storage; presently used for the storage of jet fuels and engine oils. One tank is reported to leak and is not used for POL storage. Analytical results show soil contamination at 45 feet (i.e., 4,000 mg/kg). No groundwater contamination has resulted.

REMEDIAL ACTION

Remove petroleum products from the tanks and steam clean. Bury tanks in place. Install monitoring wells.

ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

An AF Form 814 has been prepared collectively for each of the Sites 1, 2, and 5. Resources identified as potentially impacted from cleanup of these sites included:

- Biological Resources
- Cultural Resources
- Groundwater Aquifers
- Air Quality
- Health and Safety Hazards (i.e., worker exposure during removal/cleanup efforts)

Impacts to air quality (i.e., release of toxics and volatile organics), water quality and aquifer yield, and health and safety of workers involved in the cleanup of each site have been considered in the Remedial Action Plan (RAP). A separate Health and Safety Plan has been developed in the RAP to ensure adequate protection for workers. Positive results will occur from cleanup of these hazardous waste sites so far as water quality, health and safety of the general public, off-base and on-base land use is considered. The proposed remedial actions will ensure that no contamination of underlying aquifers will occur thereby protecting potable water supplies on-base as well as those of adjacent communities such as North Edwards. Aquifer yield will be enhanced because aquifers will not become contaminated. The general public will benefit from cleanup not only because of protection for the aquifer but from direct exposure to possible contaminants. On-base and off-base land use will be enhanced due to containment of contaminants and their proper disposal.

Impacts of unknown character included those to biological resources (especially threatened or rare species) and to cultural resources. A literature search and site recors search was performed to ascertain the presence of sensitive resources. No sensitive resources were identified. Field surveys were also conducted and showed no significant findings.

Impacts to air quality will result due to surface soil disturbances and increased fugitive dust. These impacts will be mitigated by applying water spray to the sites during and following grading/filling operations. The installation of impermeable caps will also reduce the quantity of fine sediments which could become airborne.

In all, a number of positive conditions will result from cleanup of the hazardous waste disposal sites on Edwards AFB. The negative impacts identified will be mitigated through responsible planning and health and safety measures. The unknown impacts have been explored and found to be insignificant.

PRELIMINARY ENVIRONMENTAL SURVEY

(CAUTION This environmental survey is a preliminary document prepared to aid in the early development of your proposal. IT IS NOT AN ENVIRONMENTAL ASSESSMENT.)

1. TITLE OF PROPOSED ACTION	2. CONTROL NUMBER
Edwards AFB IRP - Phase IV	840020

I WORKSHEET

3. *INSTRUCTIONS: Indicate the effect either on or of each appropriate attribute listed below. Additional attributes may be listed in the "other" section. + = Positive Effect; 0 = No Effect; - = Adverse Effect; U = Effect Unknown.*

4. ATTRIBUTE		+	0	–	U
EARTH	EROSION (WIND/WATER)			X	
	SURFACE STABILITY		X		
WATER	AQUATIC LIFE		X		
	FLOW VARIATION		X		
	AESTHETIC PROPERTIES AND POTENTIAL USE OF WATER	X			
	AQUIFER YIELD	X			
	CHEMICAL QUALITY (DO, pH, DISSOLVED SOLIDS, NUTRIENTS, TOXICS)	X			
	PHYSICAL QUALITY (SUSPENDED SOLIDS, OIL, TEMPERATURE)	X			
AIR	ODORS		X		
	TOXIC SUBSTANCES				X
	PARTICULATES			X	
	AIR MOVEMENT		X		
	OTHER (SULFUR OXIDES, HYDROCARBONS, NITROGEN OXIDES, CARBON MONOXIDE, PHOTOCHEMICAL OXIDANTS)				X
BIOTIC	UNDISTURBED "NATURAL" AREAS				X
	GAME ANIMALS AND FISH		X		
	THREATENED AND ENDANGERED SPECIES				X
	SPECIES BALANCE		X		
RESOURCES	FUEL RESOURCE CONSUMPTION/ CONSERVATION		X		
	NON-FUEL RESOURCE CONSUMPTION/ CONSERVATION		X		
SPEC HAZARD	RADIOACTIVITY		X		
	ELECTROMAGNETIC		X		

		+	0	-	U
ACTIVITY SYSTEMS	TRANSPORTATION SUPPLY/DEMAND		X		
	WATER	X			
	POWER/HEATING		X		
	SOLID WASTE	X			
	SEWER/STORM DRAINAGE		X		
LAND USE	FLOOD PLAINS/WETLANDS		X		
	OFF-BASE LAND USE	X			
	ON-BASE LAND USE	X			
	HISTORY/ARCHEOLOGICAL AREAS				X
	AESTHETICS		X		
	ACCESS TO MINERALS		X		
SOCIO ECONOMICS	POPULATION		X		
	HOUSING SUPPLY/DEMAND		X		
	EMPLOYMENT		X		
	COMMERCIAL ACTIVITIES		X		
	INDUSTRIAL ACTIVITIES		X		
	CULTURAL PATTERNS		X		
NOISE	ON-BASE LEVELS (AIRCRAFT AND GROUND)		X		
	OFF-BASE LEVELS (AIRCRAFT AND GROUND)		X		
OTHER	HEALTH SAFETY				X

II REMARKS

5 CONTINUE ON ____ SHEETS

1. EROSION - Water diversion trenches/berms will be constructed around each site to prevent water from covering the site.
2. WATER - Water use/quantity will be enhanced due to elimination of contamination of of subsurface aquifers.
3. AIR - Toxic air contaminants will not be emitted as no surface excavation will occur Particulates will be controlled through water spraying.
4. BIOTIC - See Appendix 1.
5. LAND USE - Land uses will be enhanced due to clean up of sites.
6. ARCHEOLOGY - See Appendix 2.
7. HEALTH & SAFETY - Separate health & safety plan is being developed for each action in The Remedial Action Plan Document.

6 NAME AND GRADE OF ENVIRONMENTAL PLANNER	7 SIGNATURE	DATE
TERRY YONKERS, GS-12	Terry Yonkers	26 JUN 84

AF FORM 814

ASSESSMENT OF THE IMPACTS TO BIOLOGICAL RESOURCES FROM CLEANUP OF THREE HAZARDOUS WASTE DISPOSAL SITES EDWARDS AIR FORCE BASE, CALIFORNIA

TERRY YONKERS
AFFTC/DEEV
EDWARDS AFB

Addendum 1

ASSESSMENT OF THE IMPACTS TO BIOLOGICAL RESOURCES FROM CLEANUP OF THREE

HAZARDOUS WASTE DISPOSAL SITES - EDWARDS AIR FORCE BASE, CALIFORNIA

INTRODUCTION

A number of biological field surveys have been conducted since 1980 1984 (during all seasons) and at Sites 1, 2, and 5 in support of the Edwards AFB Installation Restoration Program. Observations made during these surveys and the impact expected to result from clean up of the abandoned toxic waste sites are reported below.

A. SITES 1A, 1B, 1C, 1D AND 1E.

(1) Sites 1A and 1E

The area around these sites was disturbed during excavation of the trenches and from disposal operations. The vegetation has recovered to a large degree.

VEGETATION

The climax community is shadscale scrub characterized by Atriplex polycarpa. Associated species include Hymenoclea salsola and Ambrosia dumosa. Species diversity is low. No threatened or endangered plant species have been observed at these sites; none are expected.

ANIMALS

Cottontail rabits and black-tailed hares are common near sites 1A and 1E as are white-tailed ground squirrels. Common reptiles include Uta stansburiana and Cnemidophorus tigris. Burrowing owls have been observed Site 1A. No rare threatened, or endangered species have been observed within the area. The desert tortoise occurs at these sites, but is uncommon. Desert tortoises are fully protected by the State of California.

(2) Sites 1B, 1C, and 1D

The area adjacent to these sites has been disturbed. Disjunct playas are contained within Sites 1B, 1C, and 1D. The playas are void of vegetation.

VEGETATION

The climax vegetation is shadscale scrub; Atriplex polcarpa being the dominant species. Hymenoclea salaola is the most common associate; Lycium sp. Ambrosia dumosa, Grayia spinosa, and Happlopappus sp. occur but are uncommom. A number of ephemerals occur duing higher rainfall years. Most common are Coreopsis bigelovii; Malocothrix californica, Oenothera spp., Camissonia spp., Cryptantha sp. and lepedium flavum. Species diversity is high. No threatened or endangered plants have been observed; none are expected.

ANIMALS

The faunal species found at Sites 1B, 1C, and 1D are similar to those described for sites 1A and 1E. Desert tortoises have been observed near Site 1C; however, population densities are low. No rare, threatened or endangered species have been observed near these sites.

B. SITE 2

Site 2 is located near the Main Base complex. The site has been fenced. Areas within the fence were heavily disturbed during excavation of the trenches and from disposal operations. The vegetation has recovered to some extent but is comprised of short-lived, non-climax species such as Hymenoclea salsola.

VEGETATION

The climax community surrounding Site 2 is Creosote Bush Scrub with scattered Joshua trees. The dominant species within the fenced are is Hymenoclea salsola, a successional species; Lycium sp. also occurs infrequently. Joshua trees, Yucca brevifolia, occur randomly. Ephemerals are few; common species include Erodium cicutarium, Cryptantha sp., Schismus barbatus, and Camissonia sp.. No rare, threatened, or endangered species are recorded for this area and none have been observed during surveys.

ANIMALS

Common mammalian species include black-tailed hare, antelope ground squirrel, and an occassional coyote. Common reptiles are Uta stansburiana, Cnemodophorus tigris, and Callisaurus dracanoides. Burrowing owls have been observed nesting within the fence (in 1982). No rare threatened, or endangered species have been observed at the site. The rare Mojave ground squirrel has been observed approximately one mile south of Site 2.

C. SITE 5

Site 5 is located at South Base. South Base was an active complex from 1940 to 1955. A number of adminsitrative buildings. aircraft hangars, fuel storage/dispenisng systems, and housing units were located at South Base; most were removed around 1955. Site 5 is fenced; the entire area within the fence has been scraped clear of vegetation and is maintained as such for fire prevention purposes.

VEGETATION

The climax community surrounding Site 5 is Shadscale Scrub. Though the vegetation was removed during the 15 year period when South Base was active, it has recovered to a near climax state. The dominant species is Atriplex polycarpa. Ephemeral species include Erodium cicutarium, Amsinkia sp., and Schimius barbatus. Species diversity is low. No rare, threatened, or endangered species have been observed in the vicinity of the site; none are expected.

ANIMALS

Common animals observed at this site include black-tailed hares, cottontail rabbits, and (occasionally) coyotes. No rare, threatened, or endangered species have been observed at this site; none are expected.

II. IMPACTS

Grading will occur at Sites 1A, 1B, 1C, 1D, 1E, and Site 5 as a result of removing contaminated soils and installing impermeable covers. Vegetation will be removed; burrowing animals and smaller animals (such as reptiles) may be run-over during site restoration. These impacts are judged as insignificant due to the previous disturbance occurring at each of these sites; the paucity of wildlife found in the area, and the small size of the impact zone (i.e., one acre for Sites 1A and 1E, two-three acres for Sites 1B, 1C and 1D). Impacts to desert tortoises could result.

III. MITIGATION

Due to the possible occurrence of tortoises in the project area, pre-surveys will be conducted and any tortoises found will be removed outisde the impact zone.

A CULTURAL RESOURCE SURVEY OF FOUR HAZARDOUS WASTE DISPOSAL SITES AT EDWARDS AFB CA (PRELIMINARY)

RICHARD H. NORWOOD
JOAN OXENDINE
AFFTC/DEER, Stop 210
EDWARDS AFB CA

Appendix 2

INTRODUCTION

In accordance with the National Historic Preservation Act of 1966, the National Environmental Policy Act of 1969 (NEPA), the Archaeological and Historic Preservation Act of 1974, and Executuve Order 11593, a cultural resource survey was performed for four hazardous waste disposal sites at Edwards AFB CA. These hazardous waste disposal sites were created prior to the inception of current environmental policies, and efforts are now being applied to decontaminate, monitor and cap such disposal sites. The cleanup process typically involves removal of waste filled containers, removal of seriously contaminated soils, reburying of the site, capping of the former deposit, fencing the affected area, and placement of monitoring wells at appropriate points near the former deposit. Since such activities have the potential for disrupting cultural resources, a record check and survey were implemented in order to assess potential impacts and achieve compliance with pertinent legislation and policies.

RECORD SEARCH RESULTS

Through review of the up-to-date cultural resources files (topographic maps, site records and literature files) at Edwards AFB, no previously recorded significant sites were found to be located within project boundaries.

SURVEY

The cultural resource survey was performed on 14 June 1984 by Richard Norwood (DEER) and Joan Oxendine (DEER), Edwards AFB archaeologists. The survey required 13 person hours. The survey team was accompanied by Terry Yonkers (DEEV) who pointed out those areas in the vicinity of the hazardous waste disposal sites likely to be impacted by cleanup and monitoring activities. The survey team then performed a series of transects at 20 to 30 meter intervals over the areas of potential impact. The following localities were examined:

(1) Locality 1A, 1E - approximately three acres were examined. This locality is situated in the north central portion of the base within low hills surrounding Rogers Dry Lake. At least two large trenches were previously excavated here to hold hazardous waste. Vegetation coverage is sparse and consists primarily of *Atriplex sp.*. Soil composition is tan, sandy, gravelly loam.

(2) Locality 1B, 1C, 1D - approximately five acres were examined. This locality is situated approximately one mile east of locality 1A, 1E. It is situated at the base of low, sand hills and adjacent to a clay lakebed. There are at least two trenches and an acid pit at this locality. Vegetation and soil composition is similar to that at locality 1A, 1E.

(3) Locality 2 - approximately two acres were examined south of a fenced area containing buried hazardous waste. The plant community observed is Joshua/saltbrush and soil is composed of decomposed granite. This locality is located within the main base area north of Mohave Blvd, east of Lancaster Blvd, south of Forbes Ave, and west of Rosamond Blvd, and is the Main Base Hazardous Waste Disposal Site.

(4) Locality 5 - approximately two acres were examined outside and adjacent to a fenced area containing buried hazardous waste. The locality is situated in the South Base area north of Hospital Road. Vegetation is represented by Atriplex sp. and soil consists of gravelly loam. The area is north of Main Base, and is the South Base WPSA.

SURVEY RESULTS

As a result of the survey, one archaeological site was found and recorded at Hazardous Waste Locality 1B, 1C, 1D. The site consists of a light density scatter of approximately 30 flakes and one mano fragment within an area of 4800 square meters. Nonartifactual rock was also observed in apparent association with flakes. This rock consisted primarily of small fragments of basalt and white quartz. There is no evidence to indicate the existance of significant subsurface deposits.

Descriptive data were recorded on a standard California Department of Parks and Recreation site form. The site is temporarily designated EAFB-100. An institutional site number will be obtained and provided in the final report. The site has been previously impacted by one of the hazardous waste trenches. This north south trending trench roughly bisects the area of scatter. A north south trending dirt road passes through the western margin of the scatter.

No significant cultural materials were observed at Localities 1A, 1E, 2 or 5. Locality 5 is situated within an area previously recorded as KER-706 however no significant cultural material was observed within the area to be impacted. The cultural material observed here consisted of a scatter of post-1950 trash including tin cans, auto parts, fragments of china and glass.

IMPACTS

Since no cultural resources were found within Locality 1A, 1E no impacts to the cultural record are expected to occur. At Locality 1B, 1C, 1D impacts to portions of EAFB-100 are expected in the vicinity of the existing hazardous waste trench. These impacts will be generated by the grading necessary to clean and cap the trench. No cultural resources were found to exist within or adjacent to Locality 2, and no impacts to the cultural record are anticipated. A site was previously recorded within Locality 5, but no significant materials were found in the area to be impacted and no impacts to the cultural record are expected as a result of hazardous waste cleanup.

EVALUATION

As a result of the cleanup project, one cultural resource, EAFB-100 will be impacted. This site is not considered potentially eligible to the National Register of Historic Places. Criteria A does not apply because the resource cannot provide information relating to events that have made a significant contribution to the broad patterns of our history. Criteria B does not apply because there is no basis for establishing relationships between the resource and persons significant in our past. Criteria C does not apply because there is no element in the resource that embodies distinctive characteristics of a type, period or method of construction or represents the work of a master or that possesses high artistic values. Criteria D does not apply because the resource is not likely to yield information important in prehistory or history.

The information level at EAFB-100 is expected to be low. Cultural materials indicate that the site was briefly and/or sporadically used by a few individuals at an unknown time period(s). Essentially, the low quantity of items, lack of or low number of tools, and poor state of preservation at EAFB-100 render the site of little significance. The principal value of EAFB-100 is in increasing general knowledge of land use and settlement patterns.

IMPACT MITIGATION

Mitigation entails either preserving or recovering the information within sites. The basic information respresented at EAFB-100 is that prehistoric peoples exploited the site and adjacent areas. This information can be preserved by institutional recording and mapping of the resource, which are currently being undertaken. Such recording is considered a sufficient measure for reducing impact to an acceptable level. No further measures are deemed necessary or appropriate.

APPENDIX E

HEALTH, SAFETY, AND EMERGENCY RESPONSE SPECIFICATION FOR RECOMMENDED REMEDIAL ALTERNATIVES

APPENDIX E

HEALTH, SAFETY AND EMERGENCY RESPONSE SPECIFICATION FOR RECOMMENDED REMEDIAL ALTERNATIVE

INDEX

1. General
2. Hazardous Environmental Protection
3. Definitions
4. Medical Surveillance
5. Industrial Hygiene Support
6. Employee Training
7. Exclusion Zone and Special Activities
8. Personnel Protection Requirements
9. Personnel and Personnel Equipment Decontamination
10. Emergency Provisions and Portable Support Facilities
11. Emergency Plan
12. Monitoring Requirements
13. Logs and Reports
14. Identification and Control
15. Signs
16. Fire Protection and Emergency Fire Response
17. Natural Hazards
18. Submittals

Attachments: #1 Pre-Employment Medical Evaluation
#2 Certificate of Medical Examination Return to Work After Illness or Injury

1. GENERAL.

1.1 Background. This section describes the minimum safety, health, and emergency response requirements for the remedial activities at Edwards Air Force Base. The Contractor must develop a detailed Accident Prevention Plan, using this section as a basis and delineating additional details and requirements as he deems necessary.

1.2 Requirements of the Corps of Engineers Accident Prevention and Safety and Health Requirements Manual, EM 385-1-1, provide the basis for the safety program for this project. The responsibility for the implementation and enforcement of this Safety Plan lies with the Contractor and his Industrial Hygienist or the Industrial Hygienist Technician/Safety Specialist. The Contractor will take all necessary precautions for the safety of, and provide the necessary protection to prevent damage, injury or loss to:

1.1.1 All employees on the work and other persons who may be affected thereby.

1.1.2 All the work and all materials or equipment to be incorporated in the work whether on or off the site.

1.1.3 Other property at or adjacent to the Project Site.

1.3 General Site Precautions.

1.3.1 Subsites 1A, 1B, 1C, 1D, 1E. Halogenated hydrocarbons (chloroform, methylene chloride, trichloroethylene, (methylene chloride and trichloroethylene are designated carcinogens) 1,1,2,2-tetrachloroethane, and

trichlorofluoromethane) were detected in subsurface soils at subsites 1A, 1B, and 1D. With the exception of trichlorofluoromethane, the measured soil concentrations of these compounds were, for the most part, less than 1 ppm. The trichlorofluoromethane concentrations were less than 20 ppm. Halogenated hydrocarbons were not detected in surface soils at this site. There are also drums containing unknown chemicals at site 1D.

Little information is available about the contents of the drums at these sites. Some drums may contain highly hazardous materials which pose a risk of explosion as well as toxicity via inhalation and skin and eye contact. Precautions must, therefore, be taken during drum sampling and removal to minimize exposure to the drum contents via inhalation and direct contact and to minimize the risk of spills and explosion. This will require monitoring the drums for organic vapors and explosive atmospheres, using non-sparking tools, and skin and respiratory protection.

At subsite 1C, nitric acid was dumped into three pits. The subsurface soil contains nitric acid, which was detected at a maximum concentration of approximately 2 percent. It is anticipated that only Levels C and D personnel protective gear will be required during remedial action activities at Site 1. Level C gear will be required to be used during drum sampling and handling at Sites 1B and 1D.

1.3.2 Site 2. Hazards at this site are primarily due to soils contaminated with waste chemical solutions from the base plating shop, miscellaneous fuels, and fuel filters. Signs posted in the area indicate buried chromate, cyanide, nitric acid, tetraethyl lead, hydrogen peroxide, and fuels. It is anticipated that only Level D personnel protection will be required for remedial actions of Site 2.

1.3.3 Site 5. At this site, fuels and oils contaminated with water are stored in five (5) underground 50,000-gallon capacity tanks. The major hazard at this site is the potential for fire and explosion during construction activities involving emptying of the tanks and cleaning the tanks.

2. HAZARDOUS ENVIRONMENT PROTECTION PROGRAM. Construction operations under this contract will require work in a hazardous environment, and the Contractor will provide adequate protection for all personnel on site. The Contractor will establish and maintain a complete hazardous environment protection program for all personnel working or visiting at the site. The program will include support for up to three (3) full-time Government Inspectors and up to six (6) intermittent Government visitors at any one time as may be required to monitor the Contractor's progress and supervision of the work. The Contractor will not be required to provide medical support for Government employees, but will provide first aid as needed, all protective clothing, work clothes, respirators, and equipment, use of change-house and showers. The Contractor will submit the details of the program for acceptance.

2.1 The Contractor will develop a Hazardous Environment Protection program (as part of the Safety Plan) to provide protection against potential exposure to the hazardous chemicals identified at the site. For example, Site 1 chemicals include halogenated hydrocarbons (chloroform, methylene chloride, trichoroethylene, 1,1,2,2-tetrachlorethane, and trichlorofluoromethane and nitrate. Site 2 soil contaminants include chromium, cyanide,

nitric acid, tetraethyl lead, hydrogen peroxide and fuels. Site 5 contains fuels and oils contaminated with water. The program will include as a minimum, the following elements and must be approved by the Contracting Officer prior to commencement of work:

2.1.1 Medical Surveillance.

2.1.2 Industrial Hygiene Support.

2.1.3 Employee Training.

2.1.4 Different Work Area Categories.

2.1.5 Complete Respiratory Protection Program.

2.1.6 Eye Protection.

2.1.7 Skin Protection.

2.1.8 Personnel and Equipment Decontamination Facilities.

2.1.9 Emergency Provisions.

2.1.10 Recordkeeping and Reporting.

2.2 Responsibility. The Contractor will notify the Contracting Officer when the work may affect adjacent properties. All damage, injury or loss to any property caused by the work will be remedied by Contractor at no additional cost to Contracting Officer.

3. DEFINITIONS.

3.1 Site. The site is the construction area to which access will be restricted. Site boundaries are indicated on plans.

3.2 Site Conditions.

3.2.1 Hazardous Contamination. Various concentrations of chemicals in both a liquid and solid state, found in soil, drums, tanks and other miscellaneous equipment located throughout the site.

3.2.2 Nonhazardous Materials. Nonhazardous materials includes miscellaneous empty crushed drums and other debris free from gross chemical contamination.

3.3 Industrial Hygienist and Industrial Hygienist Technician or Safety and Health Specialist will be the Contractor's employees so designated and will be primarily responsible for implementation and enforcement of the Safety and Hazardous Environment Protection Programs. The Industrial Hygienist Technician and/or Safety and Health Specialist will be a full-time position and will have authority to act on all safety and health or emergency response matters on site. This person will be on site at all times during the performance of the work. Additional or backup personnel will be provided if needed to assure adequate full-time safety and health control at all times

when work is being performed. If work is proceeding at more than one site concurrently (i.e. Site 1, 2 or 5) then an industrial hygienist will be required at each site.

3.4 Qualifications. The following minimum qualifications will apply:

3.4.1 Industrial Hygienist will have a minimum of five (5) years working experience in the chemical industry and/or chemical waste disposal industry and a B.S. degree in science with a minimum of 2 years of chemistry. The AIHA Certified Industrial Hygienist will have a sound working knowledge of State and Federal occupational safety and health regulations and formal training in occupational safety and health. Name and work experience will be submitted and approved prior to submittal of the safety and emergency response plan.

3.4.2 Industrial Hygiene Technician will have a minimum of two (2) years working experience in the chemical industry and/or chemical waste disposal industry. The Industrial Hygiene Technician will have a sound working knowledge of State and Federal occupational safety and health regulations and formal training in occupational safety and health. Name and work experience will be submitted and approved prior to submittal of the safety and emergency response plan.

3.4.3 Safety and Health Specialist will have a minimum of two (2) years working experience in the chemical industry and/or chemical waste industry. The Safety and Health Specialist will have a sound working knowledge of State and Federal occupational safety and health regulations and formal training in occupational safety and health. Name and work experience will be submitted and approved prior to submittal of the safety and emergency response plan.

3.4.4 All safety and health personnel will be qualified in First Aid and CPR or other First Aid and CPR qualified individuals will be available on site.

4. MEDICAL SURVEILLANCE. The Contractor will utilize the services of a California licensed occupational health physician with knowledge and/or experience in the hazards associated with the project to provide the medical examinations and surveillance specified herein. The name of this physician will be provided to the Contracting Officer along with a certified letter stating that he has visited the site and is aware of the hazards involved.

4.1 Medical Examination. Personnel involved in this operation will be provided with medical surveillance prior to participation in on-site operations, at the conclusion of said operations, and/or at 12-month intervals during the progress of operations. The initial medical examination will include a complete medical and work history and a standard occupational (CBC), and a SMAC/23 blood chemistry screen which includes calcium, phosphorous, glucose, uric acid, BUN, creatinine, albumin, SGPT, SGOT, LDH, globulin, A/G ratio, alkaline phosphatase, total protein, total bilirubin, GGT, sodium, potassium, chloride, carbon dioxide, triglyceride, cholestrol, and a creatinine/BUN ratio. Additionally, a pulmonary function test will be performed by trained personnel to record Forced Vital Capacity (FVC) and

Forced Expiratory Volume in 1 second ($FEV_{1.0}$). An audiogram and visual acuity measurement, including color perception, will be provided. A medical certification at to the fitness or unfitness for employment on this job, or any restrictions on his/her utilization that may be indicated, will be provided by the Contractor's physician to the Contracting Officer. This evaluation will be repeated as indicated by substandard performance or evidence of particular stress that is evident by injury or time loss illness on the part of any worker. A final medical evaluation is required when employment is terminated for the individual prior to completion of the contract or at the end of the contract.

4.2 Emergency Medical Care. Acting through the physician consultant, the contractor will prearrange for emergency medical care services at a convenient medical facility. The staff at the facility will be advised of the potential medical emergencies that might result and that the patient's clothing and skin might be contaminated with specific chemicals. The Contractor will establish emergency radio communications with health services and emregency services of Edwards Air Force Base.

4.3 Time Loss Illness. Any employee who develops a time loss illness or injuries during the period of the contract (whether job or nonjob connected) must be evaluated by the Contractor's physician. The supervisor must be provided with a written statement signed by the physician prior to allowing the employee to reenter the work site. (A written statement will be submitted to the Contracting Officer as part of the safety report.)

5. INDUSTRIAL HYGIENE SUPPORT. The Contractor will obtain the services of an individual who is a certified Industrial Hygienist (see para. 3.4.1 this section), to assist in the development of the Hazardous Environment Protection Program, initial training of employees and on-site support. This Industrial hygienist should be available near the site and available for supervision of the air monitoring and other technicians on site. A list of personnel qualified as Industrial Hygienists may be obtained from:

American Industrial Hygiene Association
475 Wolf Ledges Parkway
Akron, OH 44311
Phone: (216) 762-7294

When an acceptable Hazardous Environmental Protection Plan has been developed and the initial training of employees has been completed, an Industrial Hygiene Technician or Safety and Health Specialist working under the direction of the Industrial Hygienist may be utilized for the continued on-site safety and health surveillance. The Industrial Hygiene Technician or Occupational Safety and Health Specialist will have authority to act on all health and safety measures and to establish new controls as needed. The qualifications and experience of the Contractor's safety and health personnel will be subject to review by the Contracting Officer. If the Contracting Officer determines that personnel assigned are not providing adequate safety and health controls, the Contractor will obtain the services of other safety and health personnel. Additional responsibilities of the Safety and Health Personnel are described in other parts of this Section.

6. EMPLOYEE TRAINING.

6.1 Initial Training. The Industrial Hygienist will be responsible for providing occupational hazard training to all employees, including government employees assigned to the site, prior to the commencement of work. The training program will be submitted to the Contracting Officer for review. This training will be for a minimum of eight (8) hours and will include as a minimum:

a. Acute and chronic effects of the toxic chemicals at the site.
b. Need for personal protection (effectiveness and limitations).
c. Proper use and fitting of respirator (to include drills in donning emergency respirators).
d. Prohibitions:
   Beards and long sideburns
   Contact lenses
   Eating, smoking, chewing
   Personal articles, e.g., watches, rings, etc.
   Working when ill
e. Buddy System Explained.
f. Medical Examinations.
g. Emergency response and fire fighting.

6.2 Visitor Training. The industrial hygienist will be responsible for training visitors to the site in order to make them aware of the hazards associated with the site, explain emergency procedures and the use of protective gear required during the visit.

6.3 Follow-Up Training will be provided by the Industrial Hygiene Technician or Occupational Safety and Health Specialist at least weekly and prior to each change in operations. This training will include basic training and special training. Basic training will be conducted if special problems have been observed during the previous week (i.e., improper use of respirators, protective clothing, etc.). Special training may be required if unanticipated problems occur on site or a change in cleanup operations occurs such as from drum handling at Site 1B to liner placement at Site 1C. The Technician or Specialist will also provide initial training to replacement employees using the training outlines developed by the Industrial Hygienist.

7. WORK ZONES AND SUPPORT AREAS have been established on the plans. Any variations required by the Contractor must be coordinated with Government on-site representative so that contaminated soil is contained within the smallest area possible. The Contractor will ensure that each employee has the proper personal protective equipment for the zone in which he is to perform work.

7.1 Exclusion Zone and Special Activities.

7.1.1 Exclusion Zone. Exclusion zones are identified in the plans. The boundaries of the exclusion zone may be adjusted as cleanup is accomplished.

7.1.2 Special Activities include sampling and decontamination of vehicles.

7.1.3 Personal Protective Equipment. The minimum protective equipment for work in this zone is listed in paragraph 8.1.

7.1.4 Respirator "A." Respirator "A" will be utilized for fire fighting, and other emergencies such as spill containment and cleanup, unless use of respirator B can be met (see below). (Respirator A defined in Paragraph 8.1.1.)

7.1.5 Respirator "B." Respirator "B" is the basic unit for work in the exclusion zone and on special activities. Since use of this type of respirator has limitations, the following conditions must be met: (Respirator B defined in Paragraph 8.1.2.)

a. The guidelines and procedures for utilizing this type of respirator are established in writing by the Industrial Hygienist.

b. Canisters are changed regularly as needed.

c. Continued air monitoring in each specific work zone shows that the high protection factor continues to exist.

7.2 Contamination Reduction Zone. This will be established by the Contractor as a buffer zone between the exclusion zone and the support areas (clean zone). Contamination Reduction Zone will contain the personnel and equipment decontamination station indicated in paragraph 9. Personnel protective equipment required for use in this zone is specified in paragraph 8.2.

7.3 Clean Zone will include the remaining areas of the job site. Change and shower rooms, lunch and break areas, operational direction and support facilities (to include supplies, equipment storage and maintenance areas) will be located in this area. No equipment or personnel will be permitted to enter the clean zone from the contamination reduction zone without passing through the personnel or equipment decontamination station. Eating, smoking and drinking will be allowed only in this area.

8. PERSONNEL PROTECTION REQUIREMENTS AND METHODS. All personal protective equipment must be compatible with and provide protection against the chemicals identified onsite. The following minimum special equipment is required:

8.1 Exclusion Zone, Special Activities, and Personnel Protective Equipment.

8.1.1 Respirator "A." Self contained air fed respirator operated in the pressure demand mode or other positive pressure modes. In order to supplement the self-contained air tank and extend entry times, uncontaminated air from a remote air supply may be utilized as an option on specific activities.

8.1.2 Respirator "B." Full face piece, air purifying, chemical cartridge respirator with combination high-efficiency (TLVs less than 0.05 mg/m^3) filter and organic vapor cartridges certified by NIOSH will be carried at all times in a protective cover or case and will be worn on activities as

directed by the Industrial hygienist on site where exposure to inorganic or organic vapors is suspected. Cartridge types may vary depending on the hazards identified at the site as determined by the hygienist on-site.

8.1.3 Skin. Tyvec coveralls or equivalent. An impervious apron (Seran Tyvec or equivalent) must be worn when handling liquids. Rubber boots with steel toe and shank. Gloves, nitrile rubber with certified protection factor. Gloves will be taped to the sleeves of the coveralls when liquids or contaminated soil are handled.

8.1.4 Eyes. Eye protection is required when operations present potential eye hazard if a full-face piece respirator is not worn.

8.2 Contamination Reduction Zone.

8.2.1 Respirator "B" (see paragraph 8.1.1 above) will be worn or carried at all times in accordance with paragraph 8.3.2.

8.2.2 Skin. Cloth coveralls over street clothes, gloves and leather or heavy rubber boots with steel toe (knee-high). Rubber aprons will be worn when using water or solution to remove light contamination.

8.2.3 Eyes. Eye protection is required when operation presents potential eye hazard if a full face piece is not worn.

8.3 Clothing.

8.3.1 Exclusion Zone and Special Activities. The Contractor will provide all exclusion zone clothing including underwear, socks, handkerchiefs and cold weather gear and will ensure that all items are removed in the decontamination facility and laundered. The Contractor must utilize a laundry system that ensures that contaminated clothing is free of contamination after laundering. Employees leaving the exclusion zone will remove all their clothing and shower before changing into their street clothing, before lunch and at the end of the work shift.

8.3.2 Contamination Reduction Zone. Ordinary cloth coveralls supplemented by rubber aprons may be worn in the contamination reduction zone. Rubber boots and gloves will be worn. A respirator "B" will be carried at all times for emergency purposes and will be worn on activities involving a potential exposure to organic vapors. Contamination reduction zone employees will remove their coveralls, gloves, and rubber boots and wash their hands before lunch and at the end of their work shift. (Note: Laundry is discussed separately.

8.3.3 Clothing Changes. Clean changes of clothing will be provided as needed if clothes become contaminated, but not less than one complete change will be provided for each full workday.

9. PERSONNEL AND PERSONAL EQUIPMENT DECONTAMINATION. Contractor will provide and maintain clean change rooms, lockers, and shower facilities for all personnel at the project site. Personnel will use the shower facilities before changing into their street clothes at the end of their work shift and prior to eating. Contractor will provide all required work clothes. Work

clothes will be left in the change facility. Except for contamination reduction zone underclothing, no work clothing (including undergarments, shoes, or boots) will be worn off or carried out of the project area. Soiled work clothes will be laundered by the Contractor daily. Boots, rubber gloves, and respirators will be free of soil or liquid from the exclusion zone by means of decontamination washdown performed prior to entering other areas. All required respirators will be provided and maintained by the Contractor, fit tested for the assigned individuals and maintained by the Contractor and will be cleaned daily. The Contractor will provide in the safety and emergency response Plan details explaining how the daily maintenance will be accomplished in accordance with the appropriate OSHA Standards CFR 1910.134. Each individual will be assigned a respirator. No interchanging of respirators will be permitted, therefore they must be appropriately labelled. Cartridge and filter will be changed at least daily or more frequently upon direction of the industrial hygienist if sampling data indicates potential saturation concentrations exist. A procedure will be established for assuring periodic cleaning, maintenance and changeout of filters will be provided by the Contractor. Eating, smoking, and drinking will be prohibited except in facilities provided in the support area.

9.1 Contractor will provide pure soap (nonperfumed) and shampoo for washing and showers.

9.1.1 Contractor will furnish towels, wash cloths and hair dryers.

9.2 Personnel showering will include washing of hair.

9.3 Change, Shower, Lunch and Break Facilities will be provided by the Contractor and all personnel must enter and leave the work site through the facility. Contractor must provide portable chemical toilets in the shower, change facility and two additional units elsewhere on the site including one in the contamination reduction zone.

9.3.1 General Location shown on plans.

9.3.2 Layout. The Contractor will submit a drawing for Contracting Officer review showing the layout of the actual facility.

9.3.3 Features will include:

a. Smooth, watertight floors graded to drain to facilitate daily cleaning.

b. Provisions for exclusion zone employees to remove all clothing and undergarments and "shower out" before eating lunch or leaving the work site.

c. Provisions for contamination reduction zone employees to remove protective outer clothing and wash up before eating lunch or leaving the work site. (Shower if needed.)

d. Heating and lighting system.

e. Hot and cold water system to provide warm water for showers, laundry and lavatories.

f. Benches, tables, lockers, boot racks, etc., clothing.

g. Wastewater from laundry, showers, and floor drains to be piped to a holding tank. Contractor may either tie toilets/urinals discharge into a sanitary sewer or provide chemical toilets.

h. Provisions for washing contamination and mud from shoes and rubber clothing before exclusion zone and special activities employees enter the main portion of the changehouse (mud room or area).

i. Protective clothing and undergarments will be washed using laundry detergent or soap and chlorine bleach.

j. Sufficient shower heads.

k. Towels.

l. Pure (nonperfumed) soap and shampoo will be used.

9.3.4 Decontamination Area will include area to remove surface contamination and will be equipped with a floor drain.

9.3.5 Changeroom. All exclusion zone clothing and additional clothing for decontamination reduction employees will be put on and removed in this area. Provide benches plus tables or lockers for clothing and equipment. Provide floor drain.

9.3.6 Shower Room. Sufficient shower heads will be provided including deck or mats for walkways and floor drain.

9.3.7 Utility Area will include floor drain, boot rack for washed boots to drain, hot water heater, sink and table for cleaning respirators, etc., as appropriate.

9.3.8 Lunch Room. Floor drain optional. Daily scrubbing of floor with detergent and chlorine bleach or other suitable solution required.

9.3.9 Clean Room will include lockers for employee street clothes; benches; security area for valuables (as appropriate); floor drain optional. Daily scrubbing of floor with detergent and chlorine bleach or other suitable solution required.

9.4 Equipment Decontamination Station. The Contractor will provide an equipment decontamination station within the contamination reduction zone for removing soil from all equipment leaving the exclusion zone or work site. As a minimum, this will include a high pressure wash area for equipment and vehicles as indicated on drawings and a steam cleaning system for use after the mud and/or dirt has been cleaned from the equipment. A special "clean area" will be established for performing equipment maintenance. No equipment maintenance will be conducted during unsupervised work periods. This area should be used when personnel are required by normal practices to expose

themselves to contact with ground soil (i.e., crawling under a vehicle to change engine oil). The clean area will be located in the clean zone with all equipment being decontaminated by washdown in the contamination reduction zone prior to maintenance work. Maintenance such as greasing a crane or bulldozer need not require removal to the clean area unless the job requires body contact with ground soil. Seats on equipment and vehicles used in the exclusion zone will not be cloth covered. They will be free from cracks or holes that would allow dust to enter seat padding or will be covered with a temporary sheet vinyl covering.

9.5 General. Any item taken into the exclusion zone must be assumed to be contaminated and must be carefully inspected and/or decontaminated before the item leaves the exclusion zone. Therefore, in general, vehicles, equipment and materials brought into the exclusion zone will remain on-site until no longer necessary to the project. All contaminated vehicles, equipment and materials will be decontaminated to the satisfaction of the Contracting Officer before it is taken off site. The Contractor will set up controls, certified in writing by the on site Industrial Hygienist, to assure that contaminated items do not leave the exclusion zone. Dust control measures will be utilized to prevent area contamination. Trash, rubble or other waste, including used canisters from respirators, will be disposed of as contaminated waste. Unless otherwise permitted by the Contracting Officer, all construction materials or borrow materials for this project will be delivered to a clean, off site, staging area. Materials will then be rehandled and be brought on-site in such a way as to minimize the potential for contaminants being carried off site. Separate, clearly marked parking areas will be established in the clean zone by the Contractor.

10. EMERGENCY PROVISION AND PORTABLE SUPPORT FACILITIES. When work is being accomplished in the exclusion zone or adjacent contamination reduction zone, the following portable equipment and facilities will be located in the contamination reduction zone as deemed appropriate for the operation. The emergency equipment includes:

a. A minimum of two self-contained breathing apparatus with at least two spare tanks to be donned in the event of an emergency.
b. Portable emergency shower/eye lavage with a capacity for providing clean water for at least 2 gpm for a 20-minute period.
c. Two 20-lb. ABC-type fire extinguishers.

11. EMERGENCY PLAN. Emergency plan will be posted at the changehouse and equipment decontamination station. The emergency plan will include the following minimum points.

11.1 Contractor physician name, address and telephone number.

11.2 Ambulance service name and telephone number.

11.3 Procedure for prompt notification of local health facilities and Fire Department for emergency assistance.

11.4 Each zone will contain the following posting.

11.4.1 Location of emergency showers/eye lavages as specified in paragraph 10.

11.4.2 Location of self-contained breathing devices as specified in paragraph 10.

11.4.3 Specific procedure for handling personnel with excessive exposure chemicals or contaminated soil.

11.4.4 Names and telephone numbers of doctor, industrial hygienist, ambulance, fire and police will be attached to the two way radio in a weatherproof container.

12. MONITORING REQUIREMENTS.

12.1 Personnel Monitoring. Personnel monitoring will be conducted at the start of each new activity to characterize the degree of exposure from each specific operation and for each specific contaminant. Requirements for continuous or periodic monitoring will be determined based on the initial monitoring and knowledge of the operation. Monitoring will be accomplished under supervision of the Contractor's Industrial Hygienist who will address type, frequency and duration.

12.1.1 Heat Stress Monitoring. The desert climate at Edwards AFB combined with the requirements for personal protective equipment may create heat stress. For monitoring the body's recuperative abilities to excess heat, one or more of the following techniques will be used. Monitoring of personnel wearing impervious clothing should commence when the ambient temperature is 70°F or above. Monitoring frequency should increase as the ambient temperature increases or as slow recovery rates are observed. When temperature exceeds 85°F, workers should be monitored for heat stress after every work period. Monitoring should be performed by a person with a current first aid certification who is trained to recognize the symptoms of heat stress. Other methods for determining Heat Stress Monitoring, such as the WBGT Index from ACGIH TLV Booklet can be used.

a. Heart rate (HR) should be measured by the radial pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats per minute. If the HR is higher, the next work period should be shortened by 10 minutes (or 33 percent), while the length of the rest period stays the same. If the pulse rate is 100 beats per minute at the beginning of the next rest period, the following work cycle should be shortened by 33 percent.

b. Body temperature should be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature (OT) at the beginning of the rest period should not exceed 99°F. If it does, the next work period should be shortened by 10 minutes (or 33 percent), while the length of the rest period stays the same. However, if the OT exceeds 99.7°F at the beginning of the next period, the following work cycle should be further shortened by 33 percent. OT should be measured again at the end of the rest period to make sure that it has dropped below 99°F.

c. Body water loss (BWL) due to sweating should be measured by weighing the worker in the morning and in the evening. The clothing worn should be similar at both weighings; preferably the worker should be nude. The scale should be accurate to plus or minus 1/4 lb. BWL should not exceed 1.5 percent of the total body weight. If it does, the worker should be instructed to increase his daily intake of fluids by the weight lost. Ideally, body fluids should be maintained at a constant level during the work day.

13. LOGS AND REPORTS.

13.1 The Contractor will maintain logs and reports covering the implementation of the hazardous environment protection program. The format will be developed by the Contractor to include training logs, daily logs, weekly reports and a phase-out report.

13.2 The training log(s) will include both initial training and refresher training.

13.2.1 Employee and visitor's name (attendance checked and signature).

13.2.2 Time allocation in training session.

a. Topics covered.
b. Materials used.
c. Equipment demonstration.
d. Equipment practice for each employee.
e. Prohibitions covered.
f. Beards.
g. Contact Lenses.
h. Other.
i. Buddy-System Explanation.

13.3 Refresher Training.

13.3.1 Time allocation.

13.3.2 Date and place.

13.3.3 Employee and visitor's name (attendance checked and signature).

13.3.4 Topics discussed.

13.4 Daily Logs of Safety Inspections.

13.4.1 Date.

13.4.2 Area (specific zone) checked.

13.4.3 Employees in a particular area.

13.4.4 Equipment being utilized by employees named.

13.4.5 Protective clothing being worn by employees named.

13.4.6 Protective devices being used by:
Employee (named)
Area assignment of the employee

13.4.7 Contractor Safety and Health Specialist's signature and date.

13.5 Weekly Reports.

13.5.1 Summary sheet covering the range of work being done.

13.5.2 Any incidents of:

a. Nonuse of protective devices in an area where required.
b. Nonuse of protective clothing.
c. Disregard of buddy system.
d. Violation of eating, smoking, and chewing in prohibited areas.
e. Misuse of any of the above.
f. Instances of job-related injuries and illness (an accident report will be required).
g. Signed and dated.
h. Copies of daily logs attached.
i. Personnel monitoring results.

13.5.3 Copies of Medical Certificates for employees and the waivers of visitors.

13.5.4 Contractor's Safety and Health Specialist's signature and date. The writer of the report and reviewer which must be the on-site Industrial hygienist. The Industrial hygienist can be both the writer and reviewer.

13.5.5 Date specified for the Weekly Report to be in the Office of the Contracting Officer.

13.6 Phase-Out Report. At the completion of the work, the Contractor will submit a phase-out report. The report will include:

13.6.1 Final physical/medical and decontamination certification.

13.6.2 Complete summary of monitoring accomplished on the job to include personnel, air, decontamination wash water and so forth.

13.6.3 Procedures and techniques used to decontaminate:

a. Equipment and vehicles
b. Shower facility
c. Laundry facility
d. Portable chemical toilets, etc.

13.6.4 Signed and dated by the Project superintendent and the Industrial Hygienist.

13.6.5 will be submitted to the Contracting Officer thirty (30) days prior to final acceptance.

13.7 Employer Obligation. The Contractor should be aware that Federal laws such as OSHA (29CFR) may require chemical exposure records and/or medical records be maintained by employer for a specified length of time after the termination of the exposure.

14. IDENTIFICATION AND CONTROL.

14.1 General. A check-in and check-out system will be used so that there is control and a record of each employee and piece of equipment in each specific work area. A format of the system to be used will be submitted as part of the Safety Plan.

14.2 Exclusion Zone Marking. The outer limits of the exclusion zone will be marked with steel posts topped with red paint and triangular-shaped red warning flags. The steel post will be connected with colored tape. Signs will be included ("Hazardous area - keep out").

14.3 Equipment. Equipment and vehicles entering the exclusion zone will fly an identifying red flag which will remain in place until decontamination is accomplished and the item has been cleared to leave the site. Equipment and vehicles cleared to operate in the neutral zone will fly a green flag.

14.4 Buddy System. The work in the "exclusion zone" will be scheduled so as to assure that no employee works alone.

15. SIGNS. The Contractor will post the following signs:

a. Signs will be posted at the site and at entrance roads indicating that it is a hazardous area and that unauthorized entry is prohibited.

b. Signs will be posted directing all visitors to the authorized entrance.

c. No smoking signs will be posted in the area.

16. FIRE PROTECTION AND EMERGENCY FIRE RESPONSE.

16.1 Equipment. In addition to the fire protection required by the Safety and Health Requirements Manual EM 385-1-1, the following protection is required.

a. Two (2) 20-Lb. ABC-type extinguishers at the portable emergency provisions facility.

b. A minimum size 10-BC with each vehicle and item of motorized equipment used in the exclusion area.

16.2 Fire Response - Localized Fire.

a. Immediately notify the Contracting Officer.

b. Contractor or his on-site representative will immediately call local Fire Department by two-way radio through Edwards Air Force Base Security.

c. Contractor or his onsite representative will lead a team to extinguish or control the fire using available equipment until the Fire Department arrives.

d. The Contractor will have someone meet the Fire Department at the site gate and direct them to the fire location.

e. Once the fire is extinguished, the Contractor will promptly report the facts in writing to the Contracting Officer, giving full details of the incident.

f. The Contractor is responsible for containing and collecting any contaminated fire fighting residues after the fire is extinguished.

16.3 Fire Response - Uncontrolled Fire Releasing Toxic Gases.

a. Immediately notify the Contracting Officer.

b. The Contractor will evacuate all personnel from the danger area.

c. The Contractor will immediately notify Edwards, A.F.B. Fire Department and Security Police Department and report emergency conditions requiring evacuation of nearby residents. Request medical assistance for injured personnel.

d. The Contractor will immediately notify the appropriate state and federal officials of the nature and extent of the emergency.

e. Once the fire is extinguished, the Contractor will promptly report the facts in writing to the Contracting Officer, giving full details of the incident.

17. NATURAL HAZARDS. Other natural hazards known to be on site include, but are not limited to, poisonous snakes, spiders, scorpions, etc.

18. SUBMITTALS. The Contractor will in accordance with the "Special Provisions," submit the following items:

18.1 CATEGORY I. None.

18.2 CATEGORY II (FOR APPROVAL).

Accident Prevention Plan
Site Specific Safety Plan (Safety and Emergency Response Plan)
Hazardous Environment Protection Program (para. 2)
Qualifications of Industrial Hygienist/Safety and Health Specialists (para. 3.4)
Name of Contractor's Physician (para. 4)
Medical Certifications (para. 4.1) (see Attachment #1)

Written Statement of Time Loss Illness (para. 4.3) (see Attachment #2)
Employee Training Program (para. 6)
Logs and Reports (para. 13)
Format of Check-in, Check-out System (para. 14)

(SAMPLE OUTLINE)

Att. #1

Pre-Employment Medical Evaluation

(Title of Project)

Employee's Name: ______________________________

This is to certify that I have personally conducted a complete medical and work history, a physical examination, and evaluation of the employee identified above. The examination and tests were performed by myself or by a medical laboratory certified by the State of California. The evaluation included the items shown on the list which I have attached to this form.

In my opinion, on the basis of these examinations and evaluations, I feel the employee is physically and medically qualified for the proposed employment.

Date: ______________________

Signed: ______________________________ M.D. (or D.O.)

(SAMPLE OUTLINE)

Att. #2

(Title of Project)

Certificate of Medical Examination
Return to Work After Illness or Injury

I certify that I have examined ______________________________

and declare him/her fit to return to work.

Date: ______________

Signed: ______________________________ M.D. (or D.O.)

Post-Employment Medical Evaluation

(Title of Project)

I certify that I have reexamined ______________________________

on this date following _____ of employment on the ______________________

______________________ project, and certify that he/she is free of

symptomatology and signs of impairment of health related to such employment.

Date: ______________

Signed: ______________________________ M.D. (or D.O.)

APPENDIX F

MONITORING PROGRAM

TABLE OF CONTENTS

SECTION 1	INTRODUCTION	
	Introduction	1-1
	Background	1-1
	Operation and Maintenance Philosophy	1-6
SECTION 2	MAINTENANCE	
	Site Inspection	2-1
	Maintenance Activities	2-1
	Post-Closure Well Abandonment	2-6
SECTION 3	MONITORING DEVICE SAMPLING AND ANALYSIS	
	Introduction	3-1
	Monitoring Well Development and Sampling	3-5
	Lysimeter Sampling	3-13
	Sample Handling and Preservation	3-13
	Chain-of-Custody	3-15
	Analytical Methods	3-18
SECTION 4	LAND USE RESTRICTIONS	4-1
SECTION 5	OPERATION AND MAINTENANCE BUDGET	5-1

LIST OF FIGURES

3.1	Abandoned Sanitary Landfill (Site 3), Recommended Lysimeter Locations	3-6
3.2	Sanitary Landfill (Site 4), Recommended Lysimeter Locations	3-7
3.3	Industrial Waste Pond (Site 8), Recommended Monitoring Well Locations	3-8
3.4	Rocket Propulsion Laboratory Sanitary Landfill (Site 13), Recommended Lysimeter Locations	3-9
3.5	Typical Lysimeter Installation	3-14

LIST OF TABLES

2.1	Inspection Checklist, Site 1 - North Lake Bed Disposal and Storage Site	2-2
2.2	Inspection Checklist, Site 2 - Main Base Waste Disposal Site	2-3
2.3	Inspection Checklist, Site 5 - South Base Underground Waste Petroleum, Oil and Lubricants (POL) Storage Tanks	2-4
2.4	Inspection Checklist, Sites 3, 4, 8, 13, and the Hazardous Waste Storage Yard	2-5
3.1	Summary of Monitoring Systems, Selected Remedial Actions, Sites 1 2, and 5	3-2
3.2	Summary of Monitoring Systems, Sites 3, 4, 8, 13, and the Hazardous Waste Storage Yard	3-3
3.3	Ground-Water Sampling Schedule	3-10
3.4	Sample Preservation and Holding Time	3-16
3.5	Analytical Test Methods	3-19
4.1	Recommended Guidelines for Future Land Use Restrictions at Sites 1, 2 and 5	4-2
4.2	Description of Guidelines for Land Use Restrictions	4-3
5.1	Summary of O&M Costs, Site 1	5-2
5.2	Summary of O&M Costs, Site 2	5-3
5.3	Summary of O&M Costs, Site 5	5-4
5.4	Summary of O&M Costs, Sites 3, 4, 8, 13, and the Hazardous Waste Storage Yard	5-5

SECTION 1

INTRODUCTION

SECTION 1

INTRODUCTION

INTRODUCTION

The purpose of this Operations and Maintenance (O&M) Manual is to provide specific guidance regarding long-term operation and maintenance activities for the selected remedial actions at Sites 1, 2, 3, 4, 5, 8, 13, and the Hazardous Waste Storage Yard at Edwards Air Force Base. This manual is intended to provide O&M guidance to the Base Civil Engineer and monitoring device sampling and analysis guidance to the Bioenvironmental Engineer for the next fifty (50) years.

BACKGROUND

Edwards is located in California approximately 80 miles northeast of Los Angeles. The Edwards Air Force Base Installation Restoration Program (Phase IV) Remedial Action Project involved three primary sites (1, 2 and 5) situated at remote locations on the base.

- Site 1 - North Lake Bed Disposal and Storage Site
- Site 2 - Main Base Waste Disposal Site
- Site 5 - South Base Underground Waste Petroleum, Oils and Lubricants (POL) Storage Tanks

In addition, monitoring wells and/or lysimeters were installed at five additional sites:

- Site 3 - Abandoned Sanitary Landfill
- Site 4 - Main Base Sanitary Landfill
- Site 8 - Industrial Waste Pond
- Site 13 - Air Force Rocket Propulsion Laboratory Landfill
- Hazardous Waste Storage Yard

A brief description of the history of each of the primary Phase IV sites and the selected remedial actions are described herein. Detailed information regarding these sites is contained in the Phase II and Phase IV reports.

Site 1 - North Lake Bed Disposal and Storage Site

Site 1 Description

Site 1 included five subsites used for a variety of waste disposal operations, primarily by the Air Force Rocket Propulsion Laboratory (AFRPL) and other North Base facilities. Subsite 1A was an open trench roughly 20 feet wide, 4 feet deep and 60 feet long in which thirteen 55-gallon drums of motor oil and solvent had been dumped along with other metal debris. The drums were found to contain petroleum and oils, but no PCBs, and were removed to the Defense Property Disposal Office (DPDO) and salvaged. Companion Subsite 1E was an adjacent shallow trench containing metal debris and scattered empty metal drums. Subsite 1B contained ninety-seven 55-gallon drums sitting on pallets on the edge of a dry lake bed. Most of the drums were empty; however, forty did contain liquid. Subsite 1C included three shallow earth basins in which nitric acid was dumped and flushed into the soil with water. Subsite 1D consisted of two large trenches containing approximately seven hundred 55-gallon drums. During disposal operations in the mid 1960s, contents of the drums were poured into a shallow metal pan and ignited. The empty drums were then dumped into one of the trenches with the bungs removed.

Description of Remedial Action

Subsites 1A and 1E - Motor Oil Drum Disposal Trench. Remaining debris in the sites such as, but not limited to, steel drums, filters and miscellaneous steel will be excavated, cleaned, and hauled to the Main Base sanitary landfill. Associated surface soil exposed by other cleanup actions at Site 1A will be excavated and hauled to a secure Class I contract disposal site. The asphalt in the spur road adjacent to Subsite 1A (as shown on Sheet No. 6) will be removed. Wooden posts and wire to the south of Subsite 1A will be removed and hauled to the active Main Base sanitary landfill. Each site will then be regraded by

backfilling with native soil. In the case of Subsite 1A, the sand mound located just to the south of the principal depression will be cut and used first. If additional fill material is required, it will be obtained from the designated borrow area located to the southwest of the site. In the case of Subsite 1E, fill material will be obtained from the designated borrow area located to the southeast. The borrow area will be cleared and grubbed to eliminate organic materials prior to use as fill. Each site will be graded to the contours shown on the plan and sections (Drawing No. AF 890-15-01, Sheet No. 6). After completion of the fill work at each site, each borrow area shall be graded to provide drainage as required and shall be left with side slopes no steeper than one vertical to four horizontal.

Subsite 1B - Drum Storage. Drum contents will be sampled and compatible materials combined and disposed of in a Class I disposal site. Rinsate will be collected in a portable pool for evaporation. Residue will be hauled to a Class I disposal site. All noncompatible samples will be disposed of in a Class I site also. Empty drums and associated pallets will be steam cleaned and disposed of in the Main Base sanitary landfill. The site will then be graded to minimize the appearance of a depression remaining in the playa area. Side slopes will not exceed one vertical to eight horizontal. As this site is in a playa area and because there is no apparent drainage from the site, the site may contain ponded water after rain.

Subsite 1C - Nitric Acid Pits. Without disturbing the existing surface of the three pits, except for the removal of brush or other debris which may penetrate the capping system, each of the pits shall be covered with a 6-inch layer of native sandlike material which will act as a cushion for a synthetic liner. This sandlike material will be obtained from the designated borrow area located to the south of the sites. The borrow pit will be cleared and grubbed to eliminate organic material. Each pit will be covered with an individual synthetic liner which will be anchored in a 2-foot perimeter trench which will be filled with the sandlike material. Each site will be covered with its own liner which will be of one-piece construction without field splices. A

2-foot playa clay cap will be placed over the liner and compacted to 90 percent of optimum density. The top of the cap will be sloped to drain, and the edges will be sloped as shown on the drawings (AF 890-15-01, Sheet Nos. 7 and 9) until they intersect the existing contours. Playa clay will be obtained from the designated borrow area located to the east of the site. The playa clay will be covered with 3 inches of uniformly graded crushed gravel. The maximum gravel particle size will not exceed 1 1/4 inches. In some cases, as shown on the drawings, the playa clay and crushed stone will extend to cover more than one of the subsites. After completion of the fill work at each pit, each borrow area for playa and sandlike materials will be graded to provide drainage as required. Remaining side slopes will be no steeper than one vertical to four horizontal. A 6-foot security fence will be installed around Subsites 1C and 1D.

Subsite 1D - Drum Trenches. All empty drums located at Subsite 1D will be steam cleaned on site. Rinsate will be collected in a portable pool for evaporation. The cleaned drums will be disposed of in the Main Base sanitary landfill. Residue will be hauled to a Class I disposal site. Compatible drum contents will be combined and disposed of in a Class I disposal site.

After the drums and debris have been removed, soil samples will be taken for analysis (five per trench). The trenches will then be filled with sandlike material from the borrow pit located to the south of the site to match the surrounding contours. The sand will be placed in 12-inch lifts (maximum) and will be compacted with a vibratory compactor. When the depressions have been filled, a cap will be installed. Each trench will be covered with an individual synthetic liner of one-piece construction without field splices. This liner will be anchored in a 2-foot perimeter trench filled with the sandlike material. A 2-foot playa clay cap will be placed over the liner and compacted to 90 percent of optimum density. The top of the cap will be sloped to drain, and the edges will be sloped as shown on the drawings (AF 890-15-01, Sheet Nos. 7 and 9) until they intersect the existing contours. Playa clay will be obtained from the designated borrow area located to the east of the site. The playa clay will be covered with 3 inches of

uniformly graded crushed gravel. The maximum gravel particle size will not exceed 1-1/4 inches. In some cases, as shown on the drawings, the clay and crushed stone will extend to cover more than one of the subsites. After completion of the fill work at each pit, each borrow area for playa and sandlike materials will be graded to provide drainage as required. Remaining side slopes will be no steeper than one vertical to four horizontal. A 6-foot security fence will be installed around Subsites 1C and 1D.

Site 2 - Main Base Waste Disposal Site

Site 2 Description

Site 2 is a area of approximately 14 acres that was used for disposal of waste chemical solutions from the base plating shop, miscellaneous fuels, and fuel filters. The site was used from the mid 1950s to the early 1960s and is within a mile of the Main Base area. The terrain slopes gently to the southeast towards Rogers Lake. The site was fenced and signs were posted throughout the area indicating the location of buried chromate, cyanide, nitric acid, tetraethyl lead, hydrogen peroxide and fuels. Geophysical testing with magnetometer and resistivity equipment indicated that wastes were dumped directly into shallow trenches and that no drums were buried on the site.

Site 2 - Description of Remedial Action

Site 2 shall be regraded so as to fill in the depressions and level out the mounds as shown on the drawing (AF 890-15-01, Sheet No. 8). The existing fence will be removed. The uphill side of the site shall also be graded to install a run-on control swale. This swale shall divert rainfall around the site rather than through the site. Earthwork will be so designed to utilize only existing site soil so that no material will be trucked off site.

Site 5 - South Base Underground Waste Petroleum, Oils and Lubricants (POL) Storage Tanks

Site 5 Description

This site contains five underground 50,000-gallon capacity steel tanks, each encased in concrete. These tanks were installed in 1942,

and were used for aviation gasoline storage until 1955. From 1972 to the present, three of the tanks have been used to store waste jet fuels and engine oils. The site covers approximately one acre and is completely fenced.

Site 5 - Description of Remedial Action

The contents of all the 50,000-gallon storage tanks will be pumped out by the Contractor. Water in the tanks will be transported to the industrial waste pond. Fuel/water mixtures will be transported to the new POL storage facility. All five tanks will then be cleaned in place, including dismantling pumps and associated piping. Residue and spent cleaning fluids will be collected, solidified if necessary, and disposed of in a secure Class I contract disposal site. Soil covering the tanks will be removed, two or three large holes cut in the tank tops, and local clean sand poured in to fill the tanks. The excavations will then be backfilled and graded to natural contours. Backfill material obtained from the borrow area will be compacted to 90 percent of optimum density using 12-inch maximum lifts. The cleanup work on this site will not begin until the new POL storage facility is in operation. It is estimated that this new facility will be operational January 15, 1985.

OPERATION AND MAINTENANCE PHILOSOPHY

Long-term operation and maintenance activities for the Edwards AFB remedial sites are the responsibility of the Base Civil Engineer. No special security procedures are required at these sites following the remedial construction.

In accordance with Phase IV Installation Restoration Program guidance, the remedial actions have been designed to minimize long-term maintenance. Minimal maintenance can be anticipated at this time; however, the sites should be inspected at three-month intervals. Inspection records should be maintained at the Civil Engineering Environmental Planning Office for the duration of the site life (50 years).

SECTION 2

MAINTENANCE

SECTION 2

MAINTENANCE

SITE INSPECTION

A quarterly site inspection will be required at each of Sites 1A, 1B, 1C, 1D, 1E, 2, 3, 4, 5, 8, 13 and the Hazardous Waste Storage Yard. This inspection is required to determine specific maintenance needs. Tables 2.1, 2.2, 2.3, and 2.4 illustrate the checklists which should be used as a minimum on each inspection trip. The safety and protection of the person conducting these inspections should not be of concern.

Inspection Report

Following each inspection, a written report should be prepared which summarizes the results of the field inspection and includes the following, at a minimum:

- Comment on any checklist items requiring immediate attention
- Illustrations noting areas requiring attention (8-1/2" x 11")
- Date of inspection
- Date of report
- Signature of Inspector, Base Civil Engineer

These reports will be kept on file in the Base Civil Engineer's Office for 50 years.

MAINTENANCE ACTIVITIES

Maintenance activities which may be required include, but are not limited to:

- Fence and marker sign painting or replacement.
- Removal of rooted vegetation on Subsite 1C/1D caps.

TABLE 2.1

INSPECTION CHECKLIST

SITE 1 - NORTH LAKE BED DISPOSAL AND STORAGE SITE

Item No.	Item Description	Applicability 1A	1B	1C	1D	1E
1	Check the condition of the gate lock	No	Yes	Yes	Yes	No
2	Walk the entire perimeter of the fence and look for condition of gates, fence, and fence posts and warning signs	No	No	Yes	Yes	No
3	Look for any signs of erosion around the cover areas	Yes	No	Yes	Yes	Yes
4	Look for signs of settlement	Yes	No	Yes	Yes	Yes
5	Check for exposed liner fabric	No	No	Yes	Yes	No
6	Check for weed or shrub growth on the gravel cover (Weeds should be removed)	No	No	Yes	Yes	No
7	Check the monitoring well caps and locks	Yes	Yes	Yes	Yes	Yes
8	Note any unusual condition or change to the site not listed above	Yes	Yes	Yes	Yes	Yes
9	Prepare a written report of the inspection	Yes	Yes	Yes	Yes	Yes

TABLE 2.2

INSPECTION CHECKLIST

SITE 2 - MAIN BASE WASTE DISPOSAL SITE

Item No.	Item Description
1	Walk the perimeter of the site and note condition of run-on control swale
2	Check the lysimeter caps and locks
3	Note any unusual condition or change to the site not listed above
4	Prepare a written report of the inspection

TABLE 2.3

INSPECTION CHECKLIST

SITE 5 - SOUTH BASE UNDERGROUND WASTE PETROLEUM OIL AND LUBRICANTS (POL) STORAGE TANKS

Item No.	Item Description
1	Check the condition of the gate lock
2	Walk the entire perimeter of the fence and look for condition of gates, fence, fence posts and warning signs
3	Look for signs of settlement within the fence
4	Check the monitoring well caps and locks
5	Note any unusual condition or change to the site not listed above
6	Prepare a written report of the inspection

TABLE 2.4

INSPECTION CHECKLIST

SITES 3, 4, 8 AND 13

Item No.	Item Description
1	Check the monitoring well caps and locks
2	Check the lysimeter caps and locks
3	Prepare a written report of the inspection

* Replacement of gravel or playa clay cap at Subsite 1C/1D.
* Repair of fence and markers as a result of vandalism, animals or wind.
* Picking up or collecting debris which accumulates along the inside and outside perimeter fences.
* Wind or rain erosion which may require corrective action.
* Replace or repair locks for monitoring wells.
* Fill in animal burrowings on caps at Subsite 1C/1D.
* Repair of monitoring well development pump.

POST-CLOSURE WELL ABANDONMENT

Following completion of post-closure period monitoring at Sites 1, 2, 3, 4, 5, 8 and 13, the monitoring device boreholes will be properly abandoned according to EPA 570/9-75-001, the California State Water Codes and Bulletin 74-81. The borehole will be returned to its original condition, as far as feasible, to prevent vertical movement of ground water through the borehole.

SECTION 3

MONITORING DEVICE SAMPLING AND ANALYSIS

SECTION 3

MONITORING DEVICE SAMPLING AND ANALYSIS

INTRODUCTION

The general monitoring and analysis schedule for each of the primary sites is presented in Table 3.1. A similar schedule is provided in Table 3.2 for the other sites (Sites 3, 4, 8, 13, and the Hazardous Waste Storage Yard). A general description of monitoring activities is provided below:

Site 1 - North Lake Bed Disposal and Storage Site

A total of nine monitoring wells will be installed at the subsites of Site 1. At Subsites 1A and 1E, one up-gradient and three down-gradient 4-inch diameter monitoring wells were installed to a 200-foot depth at the locations shown on the drawing (No. AF 890-15-01, Sheet No. 6). One up-gradient and four down-gradient, 4-inch diameter monitoring wells were installed around Subsites 1B, 1C, and 1D at the locations shown on Drawing No. AF 890-15-01, Sheet No. 7. Each well was installed to a depth of 200 feet.

Post closure monitoring at these wells will be conducted during the first two years on a quarterly basis. Samples will be analyzed for pH and specific conductivity in the field. The samples will then be preserved and shipped to a certified laboratory for analysis of volatile organic compounds, TOC and fuel oils (Subsites 1B, 1C, and 1D wells will also be monitored for nitrates).

If contamination is not detected during the first two years following completion of the remedial actions at Site 1, then a reduced frequency of sampling and analysis will be implemented in succeeding years. The reduced schedule will be annual sampling from years 3 through 30. In addition, following two years of analysis, only those specific

TABLE 3.1

SUMMARY OF MONITORING SYSTEMS
SELECTED REMEDIAL ACTIONS

SITES 1, 2, AND 5

Site	Monitoring System	Approx. Depth (feet)	Analytical Parameters	Frequency
1A and 1E	One up-gradient well and three down-gradient wells	200	TOC, volatile organics, pH, specific conductivity, fuel oils	Quarterly for first two years. If no contamination is detected, then annually thereafter for 30 years
1B, 1C, and 1D	One up-gradient well and four down-gradient wells	200	TOC, volatile organics, pH, specific conductivity, nitrates, fuel oils	Quarterly for first two years. If no contamination is detected, then annually thereafter for 30 years
2	One up-gradient lysimeter and two additional down-gradient lysimeters	20	pH, specific conductivity, lead, cyanide, total chromium, and hexavalent chromium	Twice per year following rain or as water is available for first two years. If no contamination is detected, then annually thereafter for 30 years.
5	One up-gradient and three additional down-gradient wells	100	TOC, volatile organics, lead, fuel oils	Quarterly for first two years. If no contamination is detected, then annually thereafter for 30 years

TABLE 3.2

SUMMARY OF MONITORING SYSTEMS

SITES 3, 4, 8, AND 13

Site	Monitoring System	Approx. Depth (feet)	Analytical Parameters	Frequency
3	One up-gradient and three down-gradient lysimeters	15-23	COD, TOC, total filterable residue, total hardness, total chlorides	Twice per year following rain or as water is available for first two years. If no contamination is detected, then annually thereafter for 30 years.
4	One up-gradient and two down-gradient lysimeters	17-25	COD, TOC, total filterable residue, total hardness, total chlorides	Twice per year following rain or as water is available for first two years. If no contamination is detected, then annually thereafter for 30 years.
8	One up-gradient and three down-gradient monitoring wells	100	COD, TOC, oil and grease, phenolics, volatile organics, total filterable residue	Quarterly for first two years. If no contamination is detected, then annually thereafter for 30 years
13	One up-gradient and two down-gradient lysimeters	17-22	COD, TOC, total filterable residue, total hardness, total chlorides	Quarterly for first two years. If no contamination is detected, then annually thereafter for 30 years

volatile organics which have been detected during the first two years will be analyzed thereafter.

Site 2 - Main Base Waste Disposal Site

An additional three lysimeters were installed at a depth of 20 feet at Site 2 at the locations shown on the drawing (No. AF 890-15-01, Sheet No. 8). Each lysimeter will be sampled twice per year following rain. The samples will be analyzed for total chromium, hexalent chromium, cyanide, lead, pH and specific conductivity. If water is not obtained in the lysimeters after five years of sampling, then the sampling and analysis will be discontinued. If water is obtained, but no contamination is detected, the frequency of sampling will be changed to an annual basis from years 5 to 30 and then be discontinued.

Site 5 - South Base Underground Petroleum, Oil and Lubricants (POL) Storage Area

Four additional monitoring wells will be installed to a 100-foot depth at Site 5 at the locations shown on the drawings (No. AF 890-15-01, Sheet No. 5). Post-closure monitoring of these wells will be conducted on a quarterly basis for the first two years. The well will be sampled and analyzed for pH and specific conductivity in the field. Samples will be preserved and shipped to a certified laboratory for analysis of volatile organics, lead, and fuel oils.

If contamination is not detected during the first two years following completion of the remedial actions at Site 5, then a reduced frequency of sampling and analysis will be implemented in succeeding years. The reduced schedule will include annual sampling from years 3 through 30. In addition, following two years of analysis, only those specific organics which have been detected during the first two years will be analyzed thereafter.

Other Sites

Lysimeters and/or monitoring wells will be installed at each of the following sites as described in Table 3.2 and illustrated in Figures 3.1, 3.2, 3.3 and 3.4.

- Site 3 - Abandoned Sanitary Landfill
- Site 4 - Main Base Sanitary Landfill
- Site 8 - Industrial Waste Pond
- Site 13 - Air Force Rocket Propulsion Laboratory Landfill

Monitoring of the wells will be conducted on a quarterly basis for the first two years. Each lysimeter will be sampled twice per year following rain during the first two years. The monitoring device will be sampled and analyzed for pH and specific conductivity in the field. Samples will be preserved and shipped to a certified laboratory for analysis of the parameters listed in Table 3.2.

If contamination is not detected during the first two years following completion of the wells, then a reduced frequency of sampling and analysis will be implemented in succeeding years as described in Table 3.2. In addition, following two years of analysis, only those specific organics which have been detected during the first two years will be analyzed thereafter.

MONITORING WELL DEVELOPMENT AND SAMPLING

In order to ensure representative ground-water samples each well must be properly developed and sampled as described herein.

Preparation Prior to Sampling

The Edwards AFB personnel responsible for sampling will follow the steps listed below prior to each sampling event:

- Assemble all field equipment necessary for sample collection (see Table 3.3).
- Inspect equipment to ensure it is working properly.
- Note any items listed in Table 3.3 which are in short supply or that are showing an indication of wear.

FIGURE 3.1

EDWARDS AFB

ABANDONED SANITARY LANDFILL (Site 3) RECOMMENDED LYSIMETER LOCATIONS

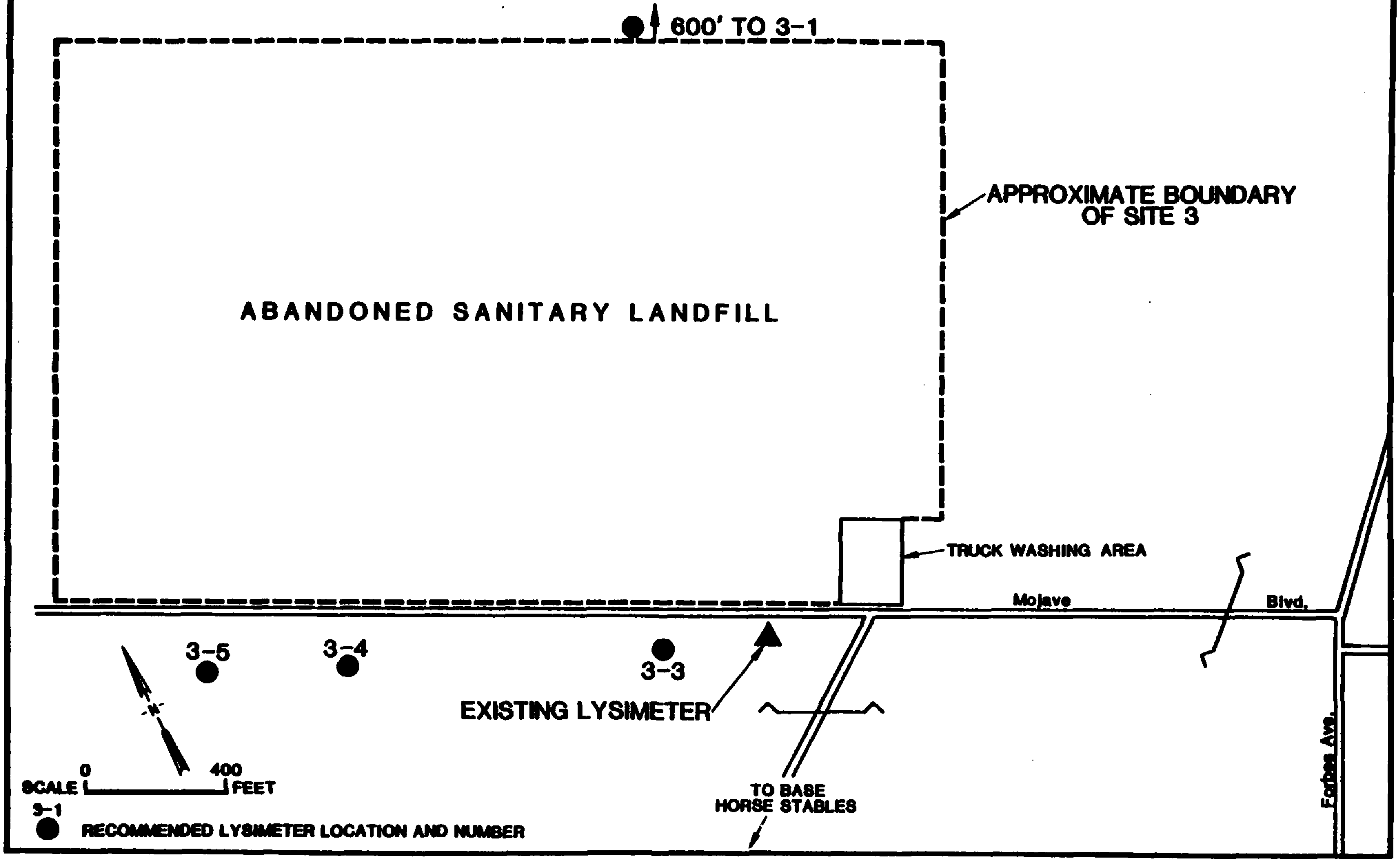


FIGURE 3.2

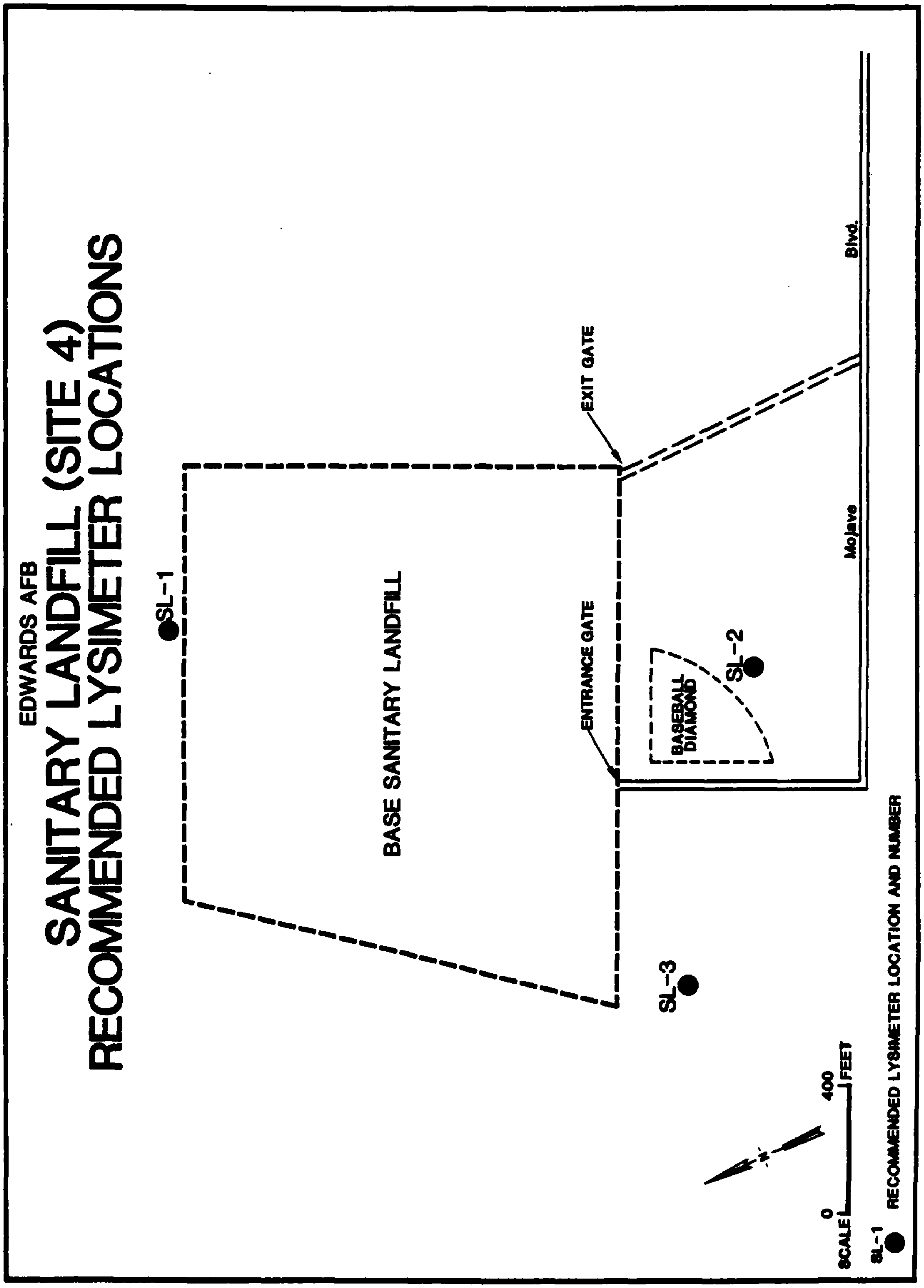
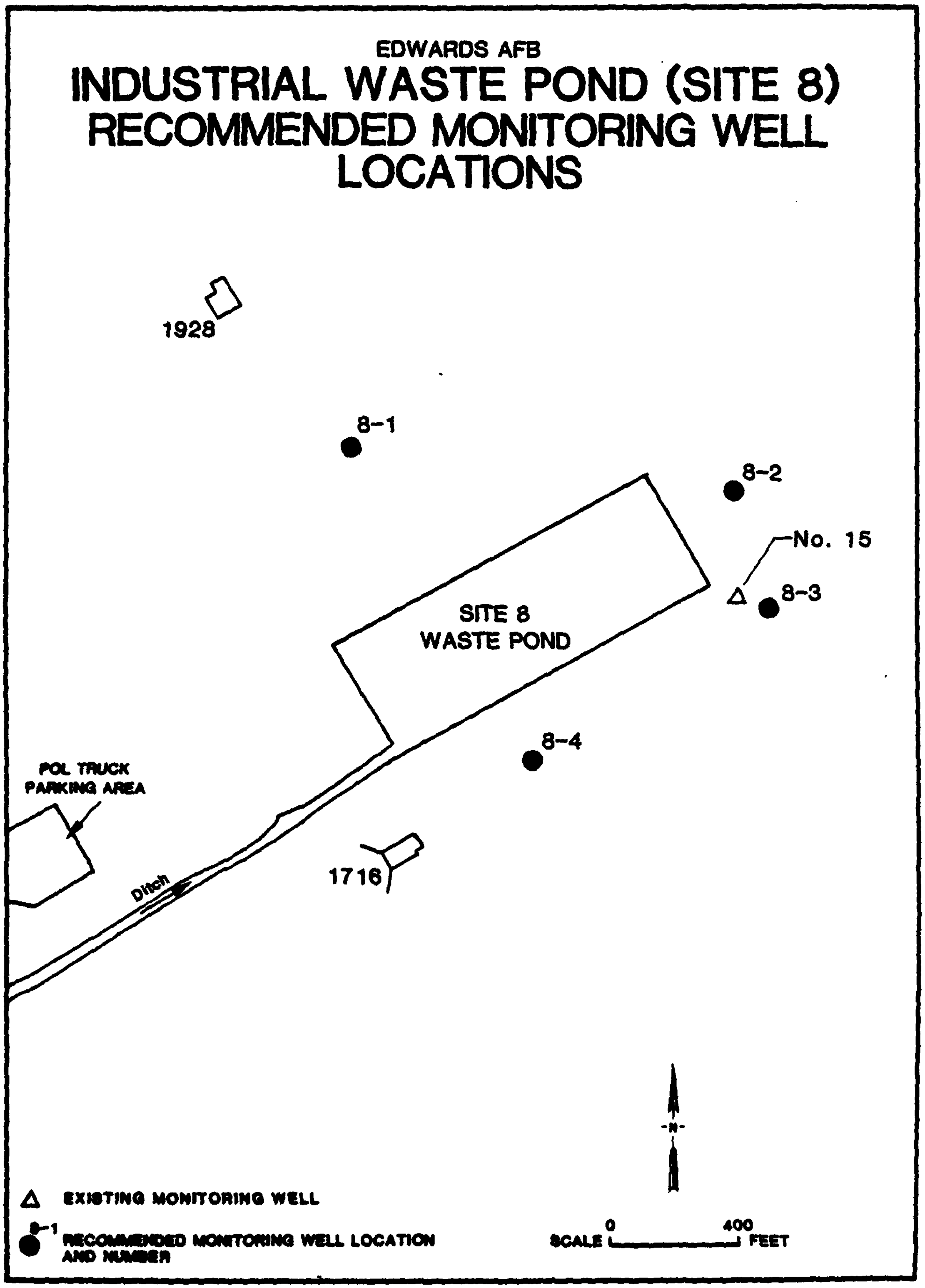
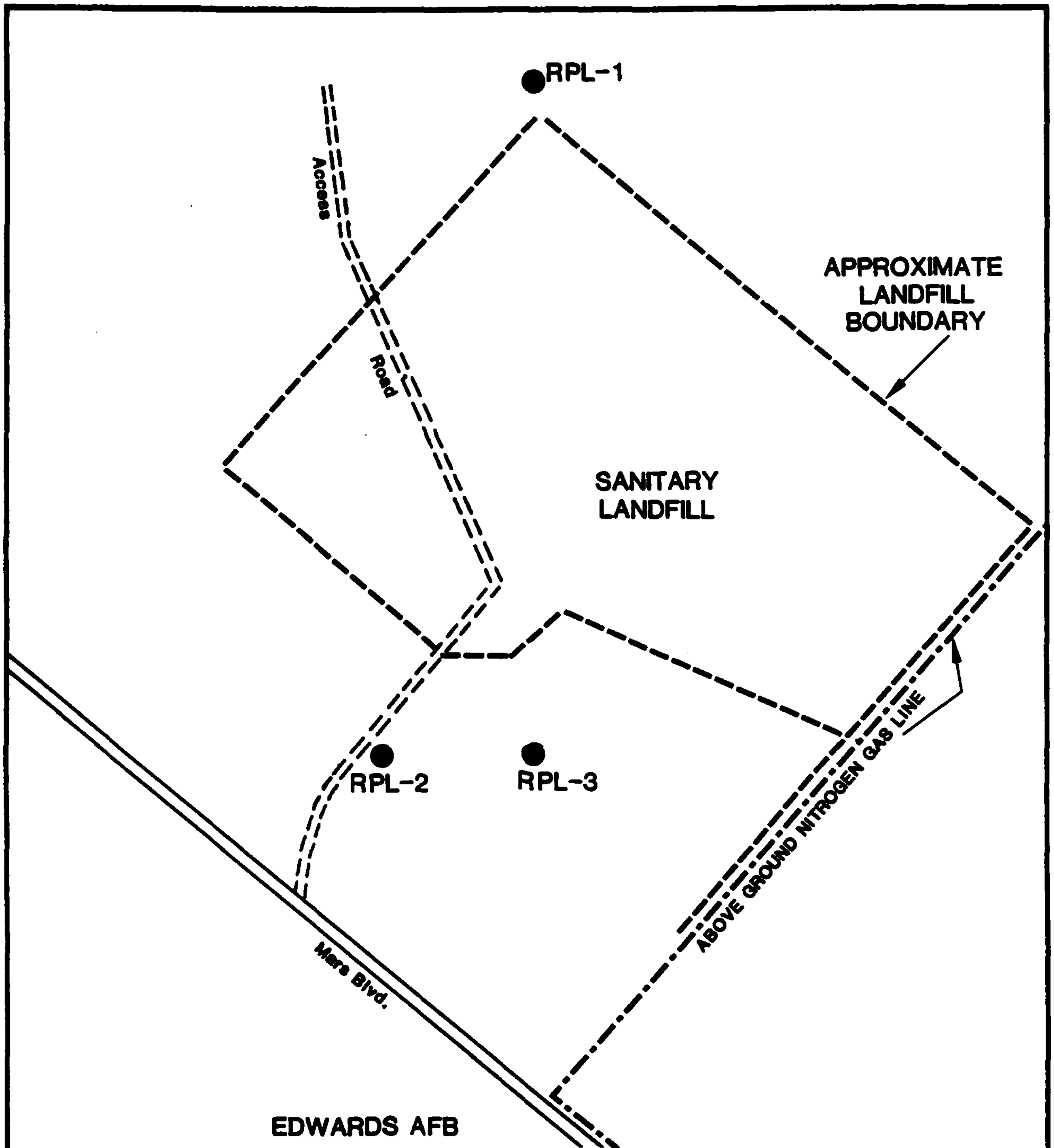

EDWARDS AFB
SANITARY LANDFILL (SITE 4)
RECOMMENDED LYSIMETER LOCATIONS
SL-1
SL-2
SL-3
BASE SANITARY LANDFILL
ENTRANCE GATE
EXIT GATE
BASEBALL DIAMOND
Mojave
Blvd.
N
SCALE
0
400
FEET
SL-1
RECOMMENDED LYSIMETER LOCATION AND NUMBER

FIGURE 3.3



ES ENGINEERING-SCIENCE

FIGURE 3.4



EDWARDS AFB

ROCKET PROPULSION LABORATORY SANITARY LANDFILL (SITE 13) RECOMMENDED LYSIMETER LOCATIONS

TABLE 3.3

GROUND-WATER SAMPLING SCHEDULE

SAMPLING EQUIPMENT

- Personal safety equipment (hard hats, etc.)
- Sampling and Analysis Program
- Appropriate number (including spares) of sample bottles
- Water-level indicator (electric drop-line)
- Ground cloth
- Distilled water
- Acetone
- Alconox detergent
- Tap water source
- Field filtration unit (0.45 - micron filter)
- Disposable surgical gloves
- Disposable towels
- pH meter
- Conductivity meter
- Buckets (small: 5 gallon; large: 25 to 30 gallon)
- Teflon well bailer
- Nylon rope (individual lengths for each well)
- Stainless steel submersible pumps
- Pump hoist

SHIPPING AND PACKING EQUIPMENT

- Shipping labels
- Sufficient ice chests to hold all sample bottles, packing material and ice

DOCUMENTATION EQUIPMENT

- Water Level Data Form
- Water Quality Data Form
- Chain-of-Custody Transfer Forms
- Waterproof pens

- Using the sampling schedule (Tables 3.1 and 3.2) and the parameter list determine which wells are to be sampled and which analyses are required for the sampling event.
- Contact the laboratory to obtain the proper sample bottles with necessary preservatives and Chain-of-Custody Forms.
- Determine any constraints such as delivery time and confirm the sample packaging and shipment method.
- Organize a sampling team of at least two people, one of whom is already familiar with the sampling procedures.

Equipment Decontamination

Prior to sampling equipment use, all equipment (bailer, water-level indicator, etc.) coming in contact with well water will be properly decontaminated. The decontamination procedure is as follows: (Bailer is used as an example.)

- Thorougly clean the bailer (disassembled) with a non-metallic detergent, such as Alconox and tap water.
- Triple rinse the bailer with distilled water.
- Rinse the bailer with acetone.
- Again triple rinse the bailer with distilled water.
- Allow bailer to air dry.
- Place bailer in clean plastic bag so that no outside contaminants are introduced.

To prevent cross-contamination between wells, a single nylon rope will be used for each well. The rope will be stored in its own separate plastic bag while not in use.

Well Purging

Well purging involves removing any stagnant water from the well casing. Prior to sampling, each well should be purged sufficiently to enable representative aquifer samples to be obtained. Wells at the Base can be purged with a 4-inch submersible pump. The pump must be decontaminated prior to use as described above.

The procedure to be followed to ensure that each well is sufficiently purged involves monitoring of the pH and conductivity of the water as the well is purged. Water pumped from each well will be discharged into a decontaminated plastic bucket and the pH and conductivity will be measured. Record the pH and conductivity on the Water Quality Data Form. The water should not be discharged within 50 feet of the well. This will prevent immediate recharge of the well with potentially contaminated water. When the pH and conductivity of the well water has stabilized, the well is sufficiently purged.

Prior to purging, the pump will be properly cleaned according to the decontamination procedures. Also prior to purging, the water level in each well should be measured to the nearest tenth of a foot and recorded on the Water-Level Data Form. The water level will be measured with an electric-drop line, the tip of which will be properly decontaminated prior to use.

The purging process will be performed as follows:

- Remove well lock and cap.
- Measure water level.
- Lower the pump to within two feet of the well bottom, remove the water from the well.
- Discharge water into decontaminated bucket and measure pH and conductivity.
- Continue purging until pH and conductivity stabilizes.
- If necessary, allow well to recover and continue pH and conductivity measurements until stabilized.
- Cap well and lock.
- Decontaminate all equipment coming in contact with well water.

Ground-Water Sampling

The ground-water sampling will be performed after each well has been sufficiently purged. Sampling will be performed as soon as possible after purging and well recovery. Recovery is that time when the water level in the well has returned to its original static water level prior to purging.

When sampling each well, the following procedures will be observed:

- Remove well lock and cap.
- Measure water level.
- Prepare appropriate sample bottles and field filtering unit.
- Remove first bailer full of water and discard into bucket.
- Remove second bailer full of water, filter water and pour into sample bottles for metal analyses.
- Remove subsequent bails to obtain sufficient water for all other bottles.
- Lock well cap.
- Fill out Chain-of-Custody Forms. Place one copy with samples.
- Place sample bottles, packing material, and ice into ice chests.
- Ship ice chests to laboratory.

LYSIMETER SAMPLING

To recover a soil moisture sample from a lysimeter (see Figure 3.5, typical lysimeter) follow the following steps:

1) Unlock the cap lock and remove lysimeter cover.
2) Install a stopcock valve and tube changes on the vacuum/ pressure tube.
3) Connect the vacuum hand pump and vacuum gauge to the vacuum/ pressure tube.
4) Remove the plastic clamps from the evacuation tube and open the stopcock valve on the vacuum/pressure tube.
5) Apply 20-40 psi pressure to force the water samples from the lysimeter to the ground surface.
6) Disconnect pump assembly and reapply vacuum to lysimeter.
7) Close protective lysimeter cover and lock.

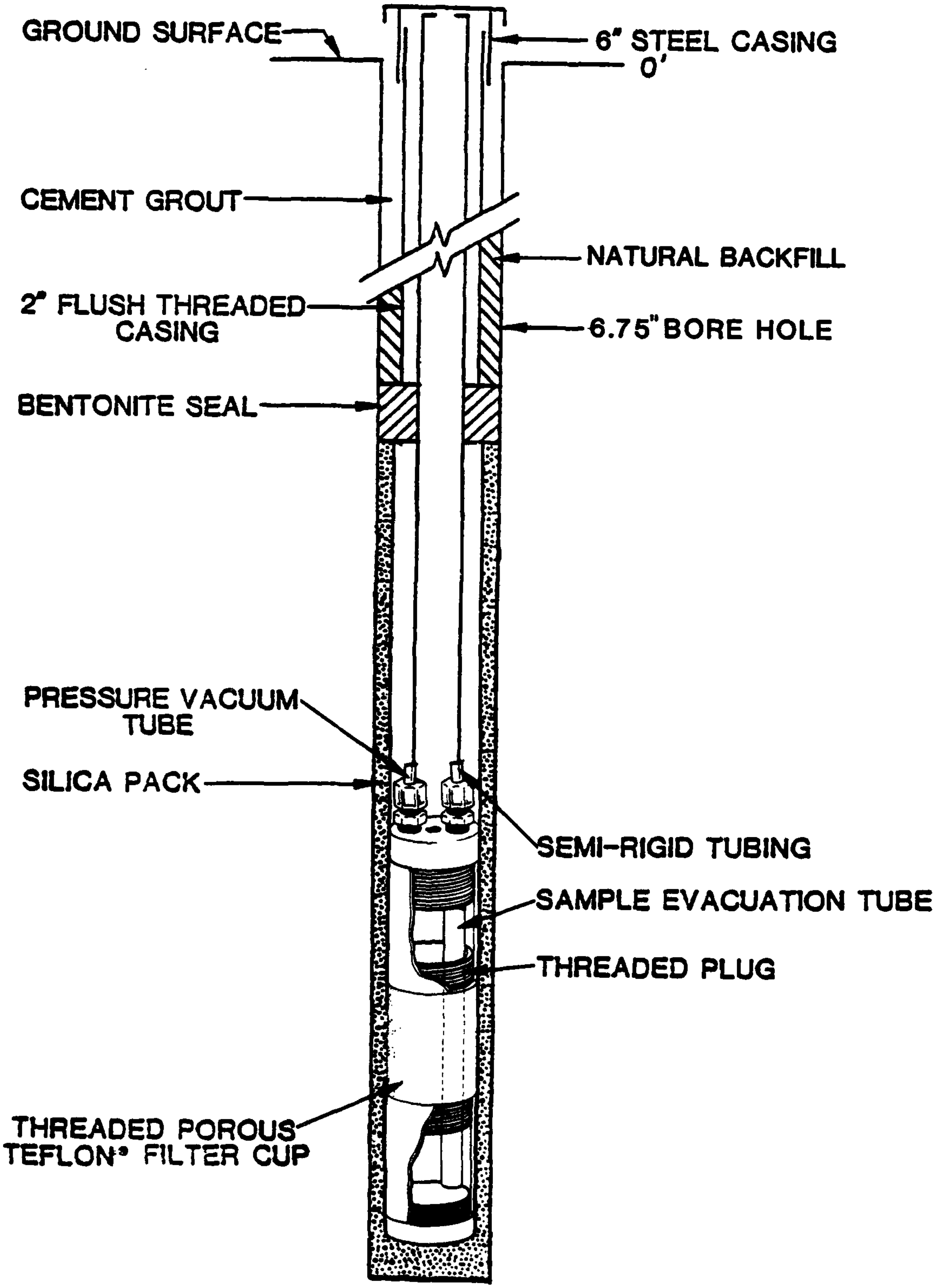
SAMPLE HANDLING AND PRESERVATION

Samples will be placed in precleaned containers suitable for maintenance of the sample integrity. A sample label will be affixed to each container to identify the date of collection, location, type of

FIGURE 3.5

EDWARDS AFB

TYPICAL LYSIMETER INSTALLATION



REFERENCE: TIMCO MANUFACTURING COMPANY

(NOT TO SCALE)

ES ENGINEERING-SCIENCE

matrix, analysis required and person collecting the sample. All samples will be tightly sealed and secured with plastic tape. The Chain-of-Custody Forms will be completed and the samples packaged for shipment to the laboratory. The samples will be packed with sufficient inert packaging material to prevent breakage and frozen Blue Ice to maintain a temperature of 4°C for up to 36 hours. The Chain-of-Custody Forms for the samples in each insulated shipping package will be placed in sealed double plastic bags to eliminate moisture damage and placed on top of the packaging material. Each package will be sealed with tape with identifying marks to ensure detection of tampering or damage during shipment. All samples will be shipped for overnight delivery by commercial carrier in accordance with applicable Department of Transportation regulations.

The type of sample containers, preservation methods and holding times recommended for each parameter to be determined are shown in Table 3.4.

CHAIN-OF-CUSTODY

The chain-of-custody shall originate with the collection of the sample and handling by the site sample custodian. The Chain-of-Custody Form will accompany all samples during shipment to the laboratory. The receiving laboratory shall have a designated sample custodian to accept delivery and assume custody of the samples. The shipping package will be inspected to ensure proper condition of the security seals, then opened and the Chain-of-Custody Forms removed. The bottle labels will be checked against the Chain-of-Custody Forms and all discrepancies noted in the sample log book. The site sample custodian and project quality assurance officers are to be notified of any irregularities in the condition of the samples as received or chain-of-custody documentation.

The samples will be stored in a secure area with limited access under environmental conditions required for maintenance of sample integrity. Laboratory chain-of-custody will be maintained until completion of the analyses and acceptance of the results.

TABLE 3.4

SAMPLE PRESERVATION AND HOLDING TIME

Parameter/Test	Sample Matrix	Method of Preservation	Sample Container	Maximum Holding Time
pH	Aqueous	Refrigeration, 4°C	500 mL glass	6 hrs.[1]
Specific Conductance	Aqueous	Refrigeration, 4°C	500 mL glass	24 hrs.[1]
Total Organic Carbon (TOC)	Aqueous	Refrigeration, 4°C H_2SO_4 to pH <2	500 mL glass	24 hrs.
Chemical Oxygen Demand (COD)	Aqueous	H_2SO_4 to pH <2	500 mL glass	7 days
Volatile Organic Compounds	Aqueous	Refrigeration, 4°C	40 mL VOA vial, Teflon lined lid	7 days
Fuel Oils	Aqueous	Refrigeration, 4°C	2L glass, Teflon lined lid	5 days till extraction
Oil and Grease	Aqueous	Refrigeration, 4°C	2L glass, Teflon lined lid	24 hrs.
Metals	Aqueous	Refrigeration, 4°C HNO_3 to pH <2	500 mL plastic	6 mos.[2]
Nitrate	Aqueous	Refrigeration, 4°C	100 mL glass or plastic	24 hrs.
Cyanide	Aqueous	Refrigeration, 4°C NaOH to pH 12	500 mL glass or plastic	24 hrs.
Total Chlorides	Aqueous	Refrigeration, 4°C	500 mL glass or plastic	7 days

TABLE 3.4 (continued)

Parameter/Test	Sample Matrix	Method of Preservation	Sample Container	Maximum Holding Time
Total Filterable Residue	Aqueous	Refrigeration, 4°C	500 mL glass or plastic	7 days
Total Hardness	Aqueous	Refrigeration, 4°C Nitric acid to pH 2	500 mL glass or plastic	6 mos.
Phenolics	Aqueous	Refrigeration, 4°C Phosphoric acid to pH <4	500 mL glass	24 hrs.

1 Field measurement recommended at time of collection.
2 14 days recommended for mercury.

ANALYTICAL METHODS

Chemical analyses are to be performed by U.S. EPA or ASTM approved methods. The test methods used to determine inorganic water quality parameters, metals, and organic compounds are listed in Table 3.5. These methods are applicable for the determination of the selected parameters in an aqueous matrix.

Inorganic Water Quality Parameters

pH

The pH of an aqueous solution is determined potentiometrically using a glass/standard reference combination electrode. The instrument is calibrated with a standard reference buffer and the linearity of response verified by measurement of standard reference buffer solutions of pH 4 and pH 10.

Specific Conductance

The conductivity of a solution is measured by the use of null balance conductance bridge equipped with fixed position electrodes. The meter is calibrated with a reference standard solution of known conductance.

Total Organic Carbon

The total organic carbon is converted to carbon dioxide by catalyic combustion. The CO_2 formed is measured by the absorbence of infrared radiation. The instrument is calibrated by the analysis of standard solutions and a response curve of absorbence versus concentration is plotted.

Nitrate

A filtered sample is passed through a glass column containing granulated copper-cadmium to reduce nitrate to nitrite. The total NO_3/NO_2 concentration is determined by diazatization with sulfanilamide and coupling with N- (1-naphthyl)-ethylenediamine dihydrochloride. The absorbence of radiation at 540 nm by the highly colored complex is

TABLE 3.5

ANALYTICAL TEST METHODS

Parameter	Test Method(s)	Description of Method	Method[1] Detection Limit
pH	EPA 150.1[2]	Potentiometry	0.01 pH units
Specific Conductance	EPA 120.1	Conductivity meter	
Total Organic Carbon	EPA 415.1	Infrared detector, CO_2	1
Nitrate	EPA 353.3	Spectrometry, (cadmium reduction)	0.01
Chromium (total)	EPA 218.2	Graphite Furnace AAS	0.003
Chromium (hexavalent)	SM 312B[3]	Spectrometry	0.005
Lead	EPA 239.2	Graphite furnace AAS	0.002
Cyanide	EPA 335.2	Spectrometry	0.02
Volatile Organic Compounds	EPA 601[4]	Gas chromatography	0.001
Fuel Oils	EPA 8015	Gas chromatography (direct injection of a carbon disulfide extract or headspace)	0.01
Total Chlorides	EPA 325.3	Titration	1
Total Filterable Residue	EPA 160.2	Filtration/Drying	1
Total Hardness	EPA 130.2	Titration	1
PCBs	EPA 608	Gas chromatography	<50 ppb

TABLE 3.5 (continued)

Parameter	Test Method(s)	Description of Method	Method[1] Detection Limit
COD	EPA 410.1 or 410.2	Reflux Method (high level) Reflux Method (low level)	50 5
Oil and Grease	EPA 413.1	Gravimetric Method	5
Phenolics	EPA 420.1	Distillation/Extraction Spectometry	0.009

1 mg/l unless otherwise designated.

2 U.S. EPA Methods of Chemical Analysis of Water and Wastes, March 1979.

3 Standard Methods for the Examination of Water and Wastewater, 15th Edition, 1980.

4 U.S. EPA Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, July 1982.

measured spectrophotometrically. The nitrate concentration is determined by measurement of the absorbence of the complex formed with a nonreduced portion of the sample and calculation by difference.

Chromium Hexavalent (Cr VI)

The Cr VI concentration is determined by measurement of the absorbence of radiation by the highly colored complex formed by the reaction with diphenylcarbazide.

Cyanide

A known volume of the sample is acidified to convert the cyanide anion to hydrocyanic acid. The acidic solution is reflux-distilled to release cyanide from complexer and the HCN is distillate is collected in a sodium hydroxide scrubber solution. The cyanide content is determined colormetrically by conversion of the cyanide to cyanogen chloride by reaction with chloromine-T at a pH <8. A colored complex is formed by the reaction of CNCl with pyridine pyrazolone or pyridine-barbitinic acid reagent.

Chromium (Total)

Total chromium is determined by digestion of the sample with nitric acid to near dryness. The residue is redissolved in dilute hydrochloric acid and filtered. The concentration of chromium is calculated from the absorbence of radiation at 357.9 nm using flame ionization atomic absorption spectroscopy.

Lead

The sample is digested with nitric acid and heated to near dryness. The residue is redissolved in dilute nitric acid, filtered and diluted to volume. The solution is analyzed by graphite furnace atomic absorption spectroscopy.

Volatile Organic Compounds

Volatile Organic Analysis (VOA) is performed by gas chromatography (GC) or gas chromatography/mass spectrometry (GC/MS). Halogenated VOAs

are determined by EPA method 601 using a halogen specific detector (Hall or Coulson). The purge and trap method is used for sample introduction into the GC column.

SECTION 4

LAND USE RESTRICTIONS

SECTION 4

LAND USE RESTRICTIONS

It is desirable to have land use restrictions for the identified sites following implementation of Phase IV remedial actions for the following reasons: (1) to provide the continued protection of human health, welfare and the environment; (2) to ensure that the contaminant migration is not promoted through improper land uses; (3) to facilitate the compatible development of future Air Force facilities; and (4) to allow for identification of property which may be proposed for excess or outlease.

The recommended guidelines for land use restrictions for each site at Edwards AFB are presented in Table 4.1. A description of the land use restriction guidelines is presented in Table 4.2.

TABLE 4.1

RECOMMENDED GUIDELINES FOR FUTURE LAND USE RESTRICTIONS AT SITES 1, 2, AND 5

Site No.	Construction on the Site	Excavation	Well Construction on or Near the Site	Agricultural Use	Silvicultural Use	Water Infiltration (run-on ponding, irrigation)	Recreational Use	Burning or Ignition Source	Disposal Operations	Vehicular Traffic	Material Storage	Housing on or near the Site
1A and 1E	NR	R	R	R	NR	R	R	NR	R	NR	NA	R
1B, 1C, and 1D	R	R	R	R	R	R	R	NR	R	R	NA	R
2	NR	R	R	R	NR	R	R	NR	R	NR	NA	R
5	R	R	R	R	NR	R	R	R	R	NR	NA	R

R: Restriction
NA: Not Applicable
NR: No Restriction

TABLE 4.2

DESCRIPTION OF GUIDELINES FOR LAND USE RESTRICTIONS

Guideline	Description
Construction on the site	Restrict the construction of structures which make permanent (or semipermanent) and exclusive use of a portion of the site's surface.
Excavation	Restrict the disturbance of the cover or subsurface materials.
Well construction on or near the site	Restrict the placement of any wells (except for monitoring purposes) on or within 500 yards of the site. This distance will vary from site to site, based on soil conditions and groundwater flow.
Agricultural use	Restrict the use of the site for agricultural purposes to prevent food chain contamination.
Silvicultural use	Restrict the use of the site for silvicultural uses (root structures could disturb cover or subsurface materials).
Water infiltration	Restrict water run-on, ponding and/or irrigation of the site. Water infiltration could induce contaminant migration.
Recreational use	Restrict the use of the site for recreational purposes.
Burning or ignition sources	Restrict any and all unnecessary sources of ignition, due to the possible presence of flammable compounds.
Disposal operations	Restrict the use of the site for waste disposal operations, whether above or below ground.
Vehicular traffic	Restrict the passage of unnecessary vehicular traffic on the site due to the presence of explosive material(s) and/or an unstable surface.
Material storage	Restrict the storage of any and all liquid or solid materials on the site.
Housing on or near the site	Restrict the use of housing structures on or within a reasonably safe distance of the site.

SECTION 5

OPERATION AND MAINTENANCE BUDGET

SECTION 5

OPERATION AND MAINTENANCE BUDGET

The operation and maintenance (O&M) costs for Sites 1, 2 and 5 are summarized in Tables 5.1, 5.2 and 5.3, respectively. The O&M costs for the other sites (3, 4, 8, 13, and the Hazardous Waste Storage Yard) are presented in Table 5.4 The estimates are for the first two years after remedial action construction. At that time, a review of expenditures should be made particularly since the monitoring well sampling frequency may change dramatically.

TABLE 5.1

SUMMARY OF O&M COSTS

SITE 1

Item Description	No. of Units	Unit	Unit Cost ($)	Total Cost ($)
Site Inspection and Report	16	each	25.00	400
Fence and Marker Maintenance	8	hour	21.54	173
Cap and Drainage Maintenance				
Mobilization D-4 Dozer		LS		200
4 Load Gravel	40	T	11.00	440
D-4 Dozer	8	hour	38.50	308
Operator	8	hour	25.28	202
Front End Loader	4	hour	45.00	180
Monitoring Well Sampling	144	hrs.	25.00	3,600
Sample Shipment	4	each	50.00	200
Sample Analysis	16	each	261.00	4176
	20	each	276.00	5,520
Subtotal				15,399
10% Contingency				1,540
TOTAL				16,939

TABLE 5.2

SUMMARY OF O&M COSTS

SITE 2

Item Description	No. of Units	Unit	Unit Cost ($)	Total Cost ($)
Site Inspection	16	hour	25.00	400
Grading and Swale Maintenance				
Mobilization		LS		200
D-4 Time	4	hrs.	38.50	154
Operator	4	hour	25.28	101
Lysimeter Sampling (3)	12	hrs.	25.00	300
Sample Shipment	2	each	50.00	100
Sample Analysis	6	each	87.00	522
Subtotal				1,777
10% Contingency				178
TOTAL				1,955

TABLE 5.3

SUMMARY OF O&M COSTS

SITE 5

Item Description	No. of Units	Unit	Unit Cost ($)	Total Cost ($)
Site Inspection	8	hour	25.00	200
Fence and Marker Maintenance	8	hour	21.54	173
Monitoring Well Sampling	64	hour	25.00	1,600
Sample Shipment	4	each	50.00	200
Sample Analysis	16	each	281.00	4,496
Subtotal				6,669
10% Contingency				667
TOTAL				7,336

TABLE 5.4

SUMMARY OF O&M COSTS

SITES 3, 4, 8 AND 13

Item Description	No. of Units	Unit	Unit Cost ($)	Total Cost ($)
Site Inspection and Report	16	each	25.00	400
Monitoring Well Sampling (4)	64	hrs.	25.00	1,600
Lysimeter Sampling (13)	52	hrs.	25.00	1,300
Sample Shipment	10	each	50.00	500
Sample Analysis	16	each	235.00	3,760
	26	each	75.00	1,950
Subtotal				9,510
10% Contingency				951
TOTAL				10,461

APPENDIX G

AIR FORCE DOCUMENTATION PLAN

APPENDIX G

DOCUMENTATION PLAN

AFFTC/DEEV will retain in their files one complete set of all working files and reports concerning the IRP work for 50 years. This documentation includes IRP Phase I, II, III, and IV reports, all reports generated by the design A/E and construction contractors, project managers' reports, and post closure reports.

Phase I, II, III, and IV reports will be approved by HQ AFSC/DEMV and will be submitted to the NTIS through DTIC. All Corps of Engineers files will be microfiched by the Corps. One copy will be provided to AFFTC/DEEV and one copy will be provided at HQ AFSC/DEMV no later than one year after the construction contract is completed.

One year after construction work is completed, AFFTC/DEEV will provide HQ AFSC/DEMV one microfiched copy of all IRP files. Every five years hence, all post closure and monitoring files will be microfiched and one copy will be provided by HQ AFSC/DEMV.

APPENDIX H

CHEMICAL ANALYTICAL PLAN

APPENDIX H

CHEMICAL ANALYTICAL PLAN

INTRODUCTION

The Chemical Analytical Plan describes the sampling procedures and analytical methods used for collection of soil and waste samples at Sites 1 and 2 at Edwards Air Force Base under the Phase IV IRP project. Samples were collected during the week of May 7-11, 1984.

The purpose of this sampling task was to determine the areal extent of chemical contamination at sites 1 and 2 so that the remedial alternatives could be selected. The sampling procedures, sample locations, and analytical parameters were chosen based on information provided in the Phase II-1 and II-2 Confirmation Reports (Reference 9 and 10) and on results of electrical resistivity and magnetometer surveys and site inspections performed by ES during the weeks of April 16 and 23, 1984.

This sampling plan is organized into the following sections: (1) Sampling and Sample Custody Procedures; (2) Analytical Procedures and (3) Quality Assurance.

SAMPLING AND SAMPLE CUSTODY PROCEDURES

Sampling and sample custody procedures were consistant with the guidelines described in "Sampling Manual for the Investigation of Hazardous Waste Disposal Sites" prepared under Contract 68-03-1614 under the Superfund Program or other EPA-approved documents related to sampling. Three basic types of samples were collected: (1) soil borings, (2) surface soil samples and (3) drummed wastes.

Sampling Procedures

All sampling equipment (drilling equipment, spatulas etc.) was precleaned prior to sample collection with a non-metallic detergent, triple rinsed with distilled water, rinsed with acetone, triple rinsed with distilled water and allowed to air dry. Precleaned sample containers, glass with teflon-lined lids, were used for sample containerization. Health and Safety precautions identified in Appendix E (Health, Safety and Emergency Response) were followed during the sampling trip.

Soil Borings (Site 2)

A split-spoon sampler was used to obtain each sample at predetermined depth. A portion of the core was transferred to an eight ounce clear glass jar and sealed with a teflon-lined cap.

Surface Soil Samples (Site 1)

All surface samples were collected with a stainless steel spatula. Samples for halogenated volatile analysis were placed in a 40 ml glass bottle and sealed with a teflon-lined cap. Samples for nitrate and pH analysis were placed in an eight ounce glass jar and sealed with a teflon-lined cap.

Drum Samples (Liquid - Subsites 1B and 1D)

A borosilicate glass tube was inserted into the drum through the bong. A sample of liquid was withdrawn by placing a gloved finger over the end of the glass tube and withdrawing the tube from the drum. The contents of the tube were then discharged to a 40 ml glass bottle and sealed with a teflon septum cap.

Sample Handling and Preservation

Samples were placed in precleaned containers suitable for maintenance of the sample integrity. Documentation of Chain-of-Custody and sampling conformed to EPA NEIC Policies and Procedures, EPA-330 9/78/001-R (as revised 1/82). Chain-of-Custody was documented on the EPA Chain-of-Custody format. A sample label was affixed to each container to identify the sample number, date and time of collection, location, type of matrix, analysis required and person collecting the

sample. All samples were tightly sealed and secured with plastic tape. The Chain-of-Custody Forms were completed and the samples packaged for shipment to the laboratory. The samples were packed with sufficient inert packaging material and frozen Blue Ice to prevent breakage to maintain a temperature of 4°C for up to 36 hours. The Chain-of-Custody Forms for the samples in each insulated shipping package were placed in sealed double plastic bags to eliminate moisture damage and placed on top of the packaging material. Each package was sealed with tape with identifying marks to ensure detection of tampering or damage during shipment. All samples were shipped for overnight delivery by commercial carrier in accordance with applicable Department of Transportation regulations. Drum samples were shipped to California Analytical Laboratories, Inc., in West Sacramento, California. Soil samples were sent to the Radian Analytical Services Lab in Sacramento, California.

A bound field log book with consecutively numbered pages was used to collect all information pertinent to the sampling. Entries in the log book included:

- Location of sampling points
- Type of waste
- Suspected waste composition
- Number and volume of samples taken
- Description of sampling point and sampling methodology
- Date and time of collection
- Sample identification number
- Field observations
- Disposition of sample.

ANALYTICAL PROCEDURES

The analytical methods used were EPA-approved standard methods where practical. Table H.1 illustrates the analytical test methods and detection limits. Sample compatibility tests were performed on the drummed wastes to determine the potential for safe compositing of the waste material for transport and disposal. These screens included:

TABLE H.1

ANALYTICAL TEST METHODS

Parameter	Matrix	Test Method(s)	Description of Method	Method[1] Detection Limit
pH	Soil	EPA 150.1 on a 1:1 water slurry	Potentiometry	0.01 pH units
Nitrate	Soil	EPA 353.1 on a water leach	Technicon Auto Analyzer	0.1
Chromium (Total)	Soil	EPA 200.7	Inductive Coupled Plasma	0.1
Chromium (Hexavalent)	Soil	SM312B[3]	Spectrometry	0.1
Lead	Soil	EPA 200.7	Inductive Coupled Plasma	0.1
Cyanide	Soil	EPA 335.2	Spectrometry	0.1
Halogenated Volatiles	Soil	SW-846 Method 8010	Gas Chromatography with Hall Electron Conductivity Detector	.001
PCB	Oil/ aqueous	EPA Method 608	Gas Chromatograph/ Electron Capture	5
Water Miscibility	Oil/ aqueous	Visual Observation	Observe layer formation	NA
Reactivity	Oil/ aqueous	Visual Observation	Observe heat generation	NA
pH	Oil/	EPA 150.1[2]	Potentiometry	0.01 pH units
Cyanide	Oil/ aqueous	EPA 335.2	Spectrometry	0.1
Sulfide	Oil/ aqueous	EPA 376.1	Titration	0.5
Flash Point	Oil	ASTM D56	Closed Cup	NA
Priority Pollutants	Aqueous	EPA 625	GC/MS	5 (acid) 1 base/neutral

NA: Not applicable

1. water miscibility/reactivity
2. pH or corrosivity
3. flash point or ignitability
4. cyanide
5. sulfide

QUALITY ASSURANCE

Internal quality control checks were made to evaluate periodically the terms of performance reliability for each measurement parameter. Internal QC checks included analyses of blank samples, duplicate or split samples or spiked samples (and reference standards as appropriate) followed by appropriate corrective measures to be taken if values were outside established control limits where the nature of the samples was such that use of control limits was applicable. If not, additional replicates or other corrective action was required.

Quality control samples were analyzed at a frequency of 10 percent unless required at a higher frequency by method specific procedures (e.g., surrogate, spiking of samples to be analyzed by GC/MS).

APPENDIX I

SUPPLEMENTAL PHASE IV SITE CHARACTERIZATION DATA FOR SITES 1 AND 2

APPENDIX I

SUPPLEMENTAL PHASE IV SITE CHARACTERIZATION DATA FOR SITES 1 AND 2

INTRODUCTION

Engineering-Science (ES) has conducted a geophysical survey and additional soil sampling and analysis to further delineate vertical and/or horizontal contamination at Sites 1 and 2 at Edwards AFB. This supplemental site characterization data when evaluated together was needed to select and define the most practical remedial action for each site under Phase IV of the IRP. It should be emphasized that the evaluation of extent of contamination must be based on a consideration of the results of the geophysical survey and drilling program together; independently considered, the results can easily be misinterpreted.

GEOPHYSICAL SURVEY

Geophysical Survey Field Program - General Objectives and Methodology

Objectives

The general objectives of the geophysical survey field program at Edwards AFB were (1) to determine the location of any buried steel drums, other buried containers and/or waste pits and (2) to determine the presence of and the horizontal and vertical extent of any contaminant plume. These two objectives were addressed with the application of electrical resistivity and magnetic surveys.

Electrical Resistivity Methodology

The electrical resistivity survey consisted of both vertical and horizontal resistivity earth measurements. These measurements, obtained with a Bison Earth Resistivity Model 2350B Meter, indicated the relative electrical resistance in ohms of the earth to the conductance of an

induced electrical current through metal probes or electrodes pushed into the ground. As an example of the resistivity nature of the subsurface, a fresh-water uncontaminated aquifer will exhibit a relatively high resistivity, whereas a fresh-water contaminated (with organics and/or metals) aquifer will exhibit a relatively low resistivity.

Vertical resistivity measurements are termed soundings indicating the variation of resistivity at various depths at one ground-surface point. The resistivity sounding method applied at Edwards AFB was the "Modified Wenner Electrode Array" (Carrington and Watson, 1981). In this method the current electrodes (those furthest from the center of the array) are stationary while the potential electrodes (those closest to the center of the array) are moved away from the center at equally spaced distances. In the "Modified Wenner Electrode Array" the potential electrode distance closely approximates the depth of investigation into the subsurface. For example, a sounding with a total potential electrode distance of thirty feet would indicate resistivity values at approximately thirty feet below the ground surface.

Horizontal resistivity measurements, on the other hand, are termed profiles indicating the variation of resistivity at one approximate depth at many ground-surface locations. The resistivity profile method applied at Edwards AFB was the standard Wenner Array (Bison, 1975). In this method the current and potential electrodes are pushed into the ground at equal distances from one another. The depth of investigation is a zone of the subsurface approximately three-fourths to one times the electrode spacing. For example, an electrode spacing of fifty feet in the Wenner Array would investigate a zone of the subsurface between approximately 38 to 50 feet deep. At least four Wenner Arrays were utilized at each of the sites at Edwards AFB to distinguish shallow and deep subsurface variations in resistivity.

Magnetic Survey Methodology

The magnetic surveys at Edwards AFB were conducted utilizing a Geometrics Model 816/826A Magnetometer. The magnetometer indicated the magnetic field intensity in gammas of the earth at a single ground-surface point. The successful application of the magnetometer is

determined by the magnetic intensity of the target and by the distance the target is buried below ground surface. For example, a large number of steel drums buried 10 to 20 feet deep will cause a relatively high magnetic value over background and will be easily detected with a magnetometer. On the other hand, only one drum buried 50 feet deep will cause a relatively low magnetic value over background and will not be easily detected with a magnetometer. The magnetometer will also detect areas where soil has been disturbed such as in a pit or trench. Once the natural magnetic field of the undisturbed soil has been altered by the excavation and/or burial of foreign material, the change in the magnetic field over the area can be detected by a magnetometer.

Geophysical Survey Field Program - Site Specific Objectives

Site 1

The geophysical survey field program objectives at Site 1 were (1) to determine if steel drums had been buried in areas not already identified and (2) to determine the horizontal and vertical extent of any contaminant plume. The magnetic survey was conducted first and was limited in scope due to the small areas of the site. The survey included areas at 1A, 1B, 1C, 1D and 1E. The second objective was addressed with a resistivity survey. Both soundings and profiles were conducted. Soundings were conducted to establish an interpretation of existing subsurface stratigraphy which was developed with data obtained during the Phase II Program. Soundings were conducted at areas 1A and 1C where deep boring location profiles were conducted in the immediate vicinity of all of the areas.

Site 2

The objectives at Site 2 were (1) to determine the location of pits, trenches and any contaminant plumes. The magnetic survey was conducted within the fenced area of Site 2 and at selected points outside the fence. The resisitivy survey was conducted up-gradient, within the fenced area and down-gradient of the fenced area.

Geophysical Survey Findings - Sites 1A and 1E - Magnetic Survey

Magnetic surveys were conducted at Subsites 1A and 1E on April 29, 1984. The magnetometer base station readings varied from 49,914 to 49,915 gammas. At Subsite 1A the exposed scrap metal and overhead powerline interfered with the magnetic survey. At site 1E east-west traverses were conducted on both the north and south sides of the open trench containing scrap metal. While the survey showed no presence of buried ferromagnetic material north of the open trench, the survey did show results indicating buried ferromagnetic material south of the open trench (Figure I.1). The buried material is approximately 25 feet wide and 100 feet long. Values as shown in Figure I.1 varied from 50,004 to 50,054 in the area of buried material. The natural background magnetic values ranged from 49,914 to 49,915 gammas. This material is most likely scrap metal debris similar to the scattered debris in the open trench.

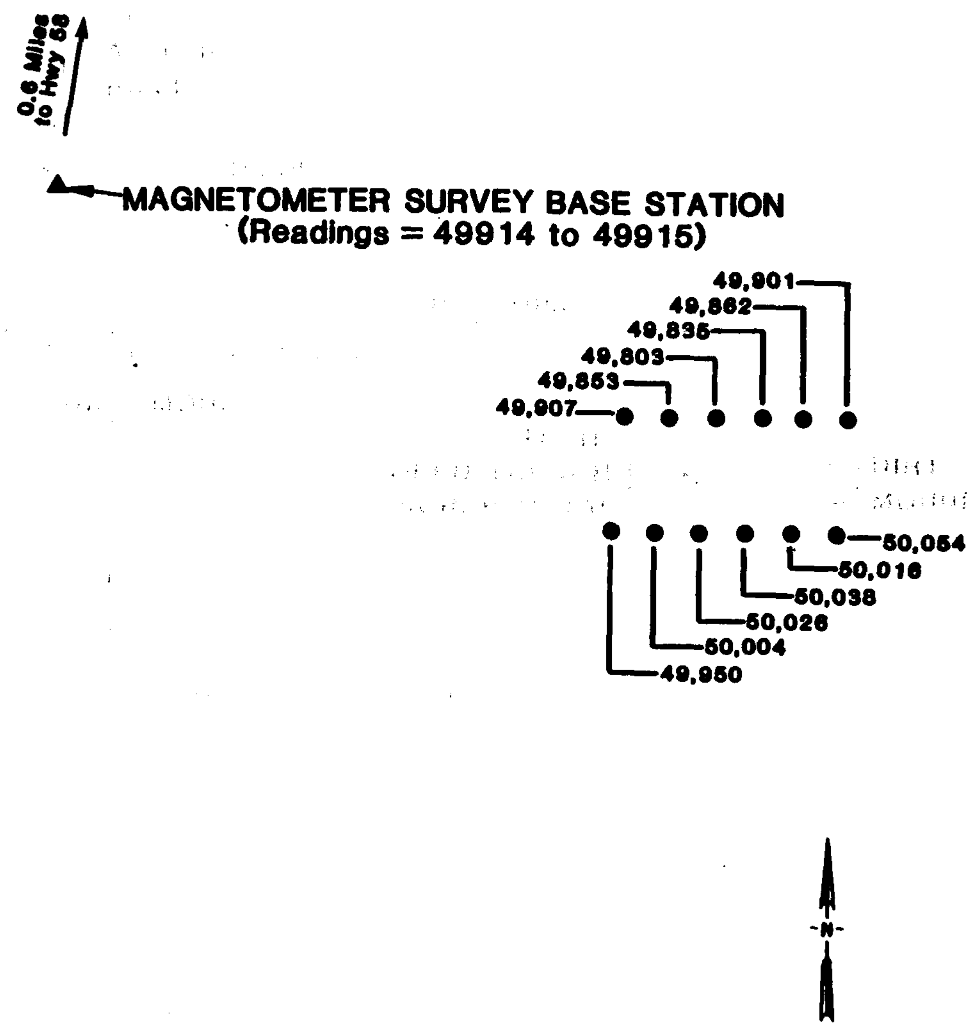
Subsites 1A and 1E - Resistivity Survey

The resistivity survey at Subsites 1A and 1E consisted of both soundings and profiles. At Subsite 1A a sounding was conducted in the center of the site to a depth of 150 feet. The apparent resistivity values are plotted versus the potential electrode spacings (depth below ground) on Figure I.2. Good geologic correlation was established between the sounding graph and the log of boring ES-1A.

Profiles at Subsite 1A consisted of electrode spacings of 10, 30, 50, 100 and 150 feet. These spacings were chosen to indicate the apparent resistivity of subsurface zones corresponding to the geologic zones as shown on the sounding in Figure I.2. Figure I.3 thru I.7 show the profile station locations and the measured apparent resistivity at each station. The profile map at 10 feet (Figure I.3) indicates a small resistivity anomaly in the center of the site. Resistivity values are lower in this small area whereas values outside the area are much higher. The lower values are interpreted as contaminated soil. The maps at 30 feet and 50 feet (Figure I.4, and I.5) indicate relatively consistent values throughout the Subsite 1A and 1E areas. The map at 100 feet (Figure I.6) indicates relatively consistent values, but a

FIGURE I.1

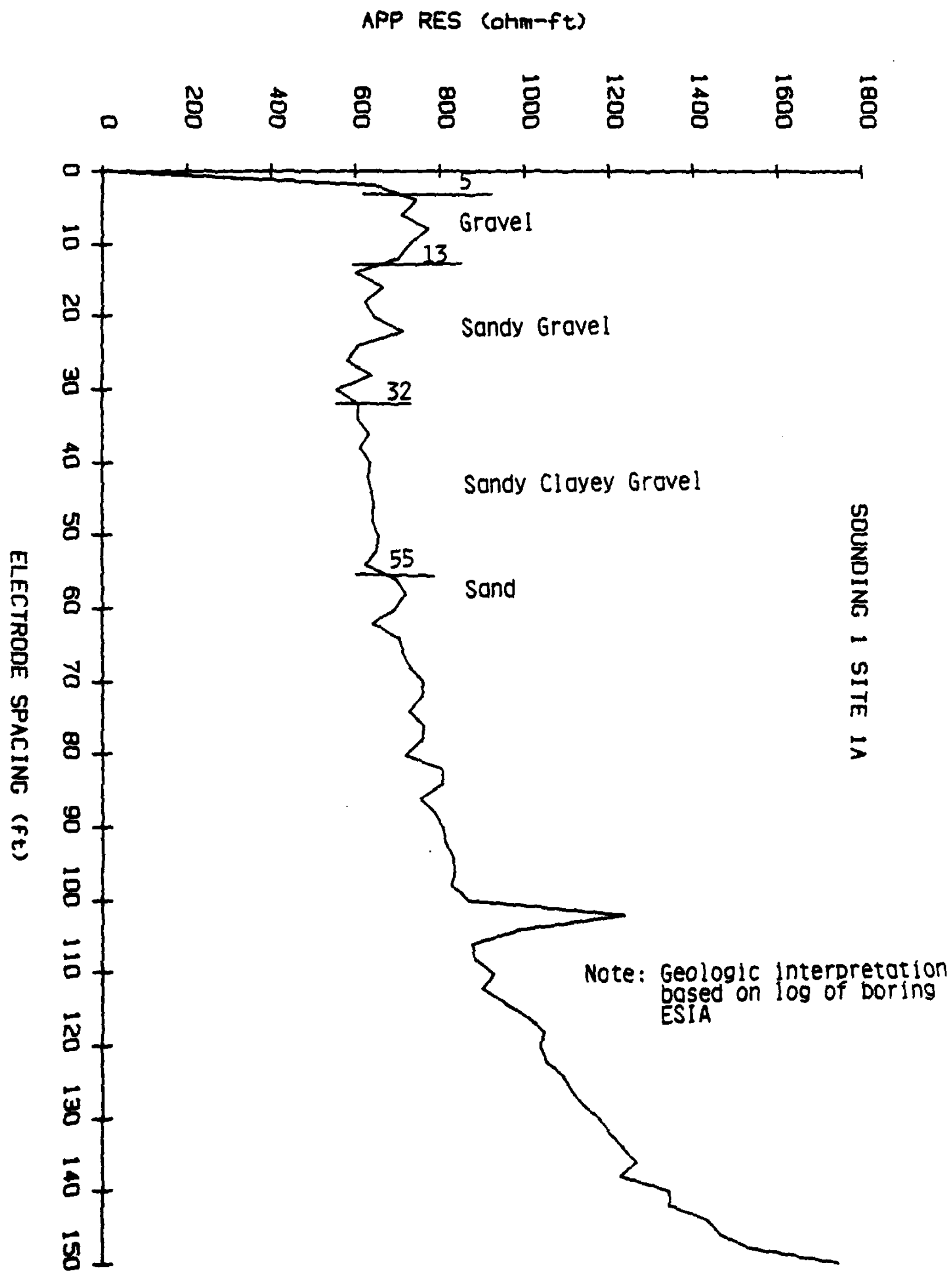
EDWARDS AFB
MAGNETOMETER SURVEY RESULTS SITES 1A & 1E



LEGEND

● Magnetometer Reading in Gammas

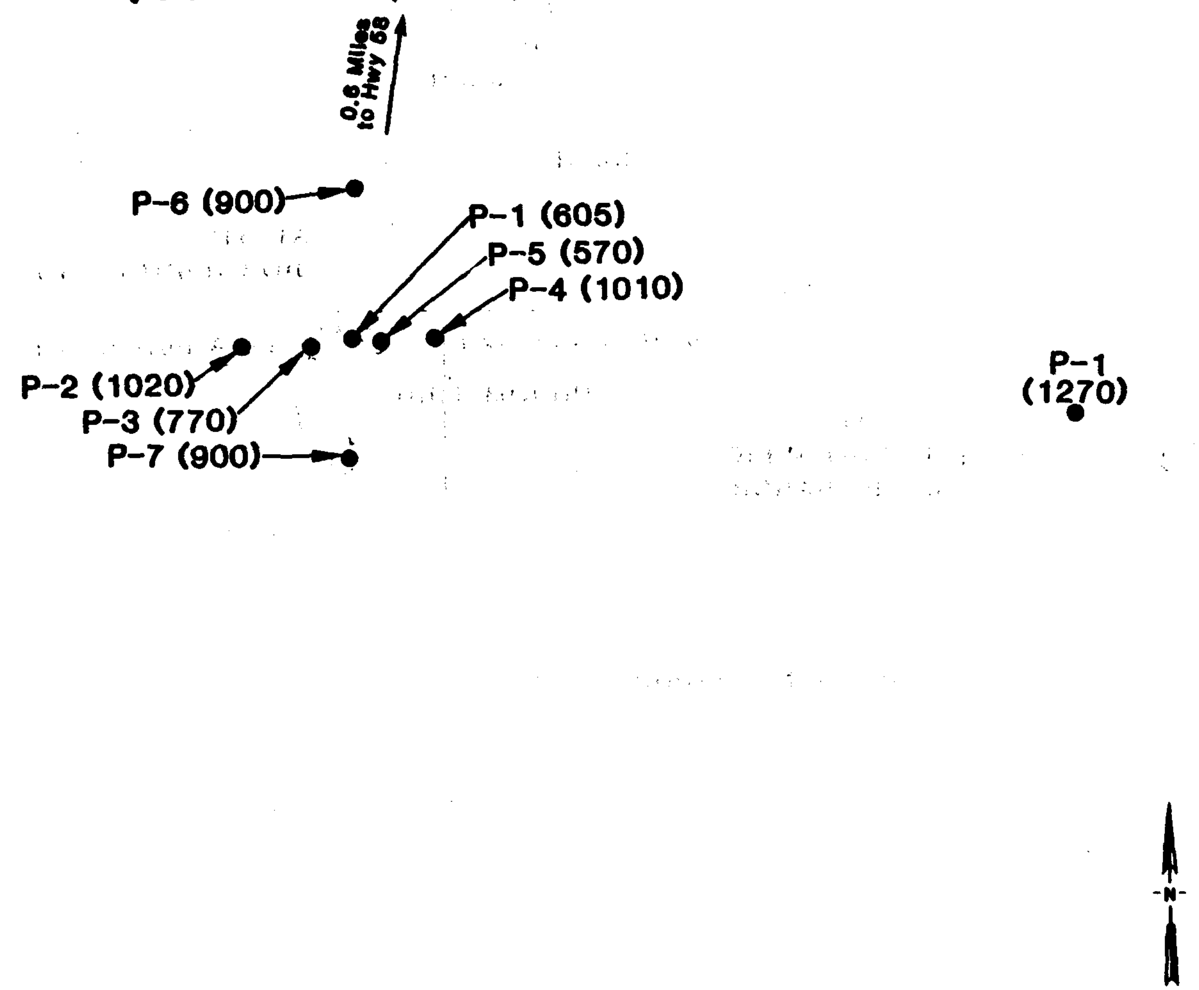
FIGURE I.2



APP RES (ohm-ft)
0
200
400
600
800
1000
1200
1400
1600
1800
ELECTRODE SPACING (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
5
Gravel
13
Sandy Gravel
32
Sandy Clayey Gravel
55
Sand
SOUNDING 1 SITE 1A
Note: Geologic interpretation based on log of boring ESIA

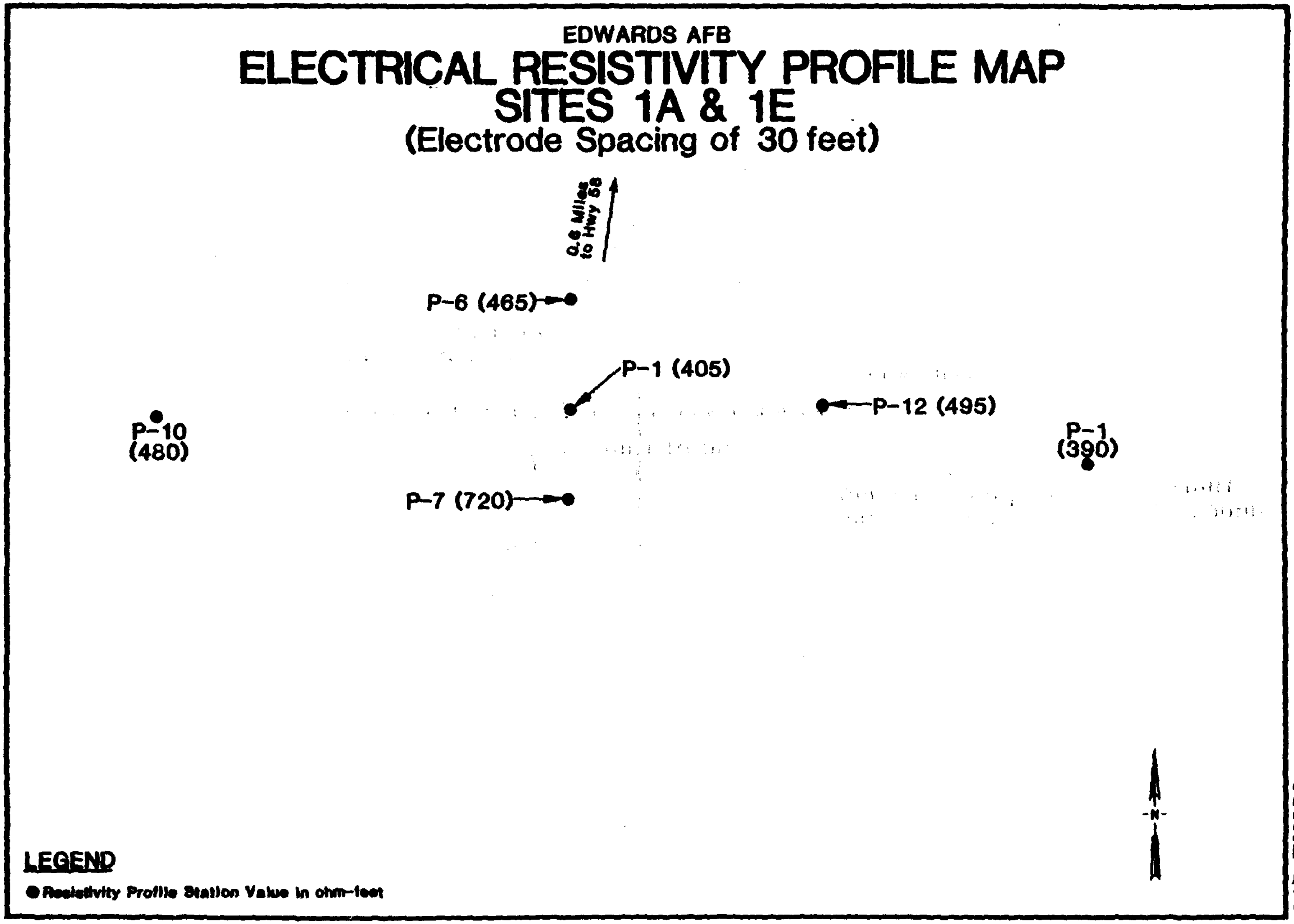
FIGURE I.3

EDWARDS AFB
SITES 1A & 1E
ELECTRICAL RESISTIVITY PROFILE MAP
(Electrode Spacing of 10 feet)



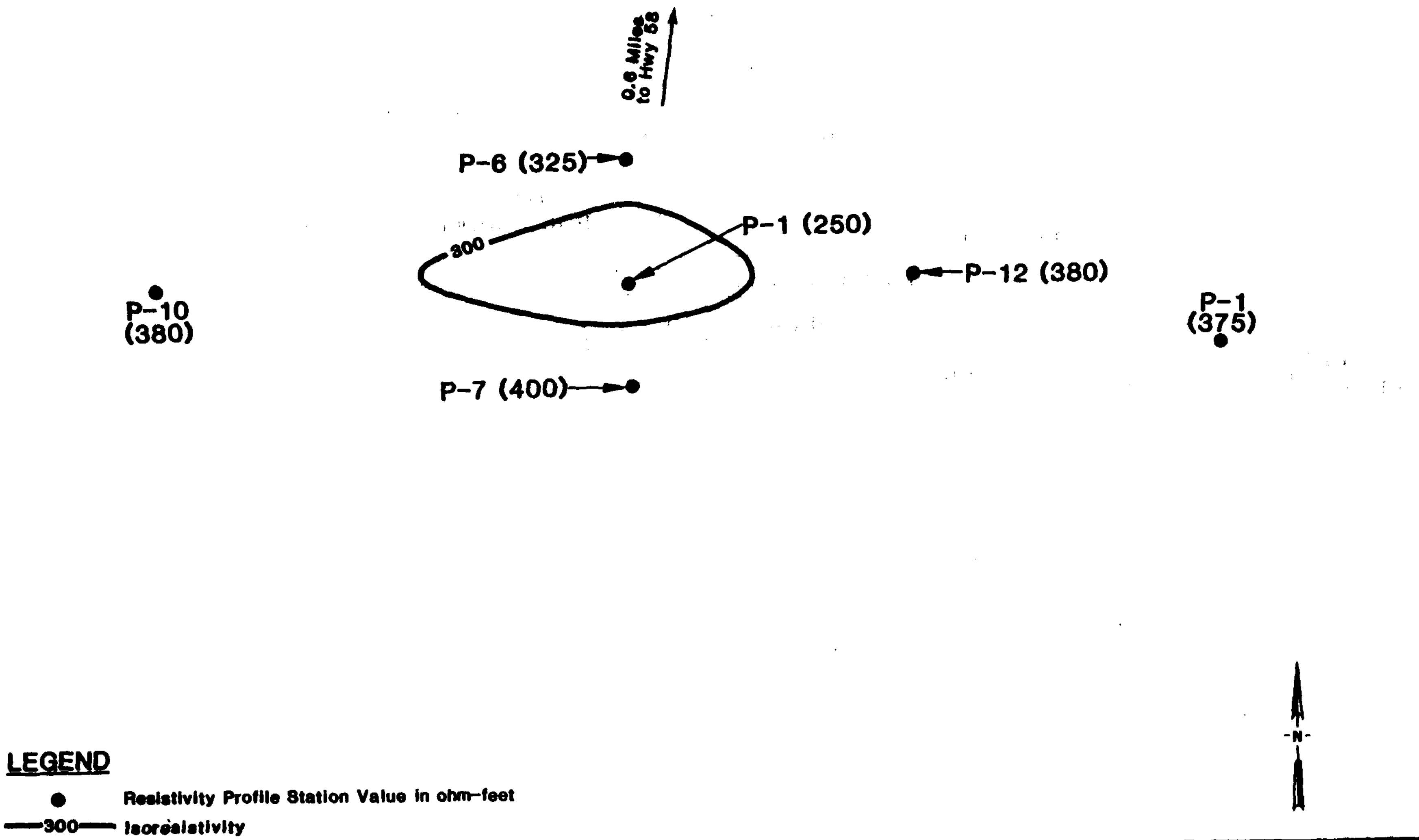
LEGEND
● Resistivity Profile Station Value in ohm-feet

ES ENGINEERING-SCIENCE


EDWARDS AFB
ELECTRICAL RESISTIVITY PROFILE MAP
SITES 1A & 1E
(Electrode Spacing of 30 feet)
0.6 Miles to Hwy 58
P-6 (465)
P-1 (405)
P-12 (495)
P-10 (480)
P-1 (390)
P-7 (720)
N
LEGEND
● Resistivity Profile Station Value in ohm-feet

EDWARDS AFB

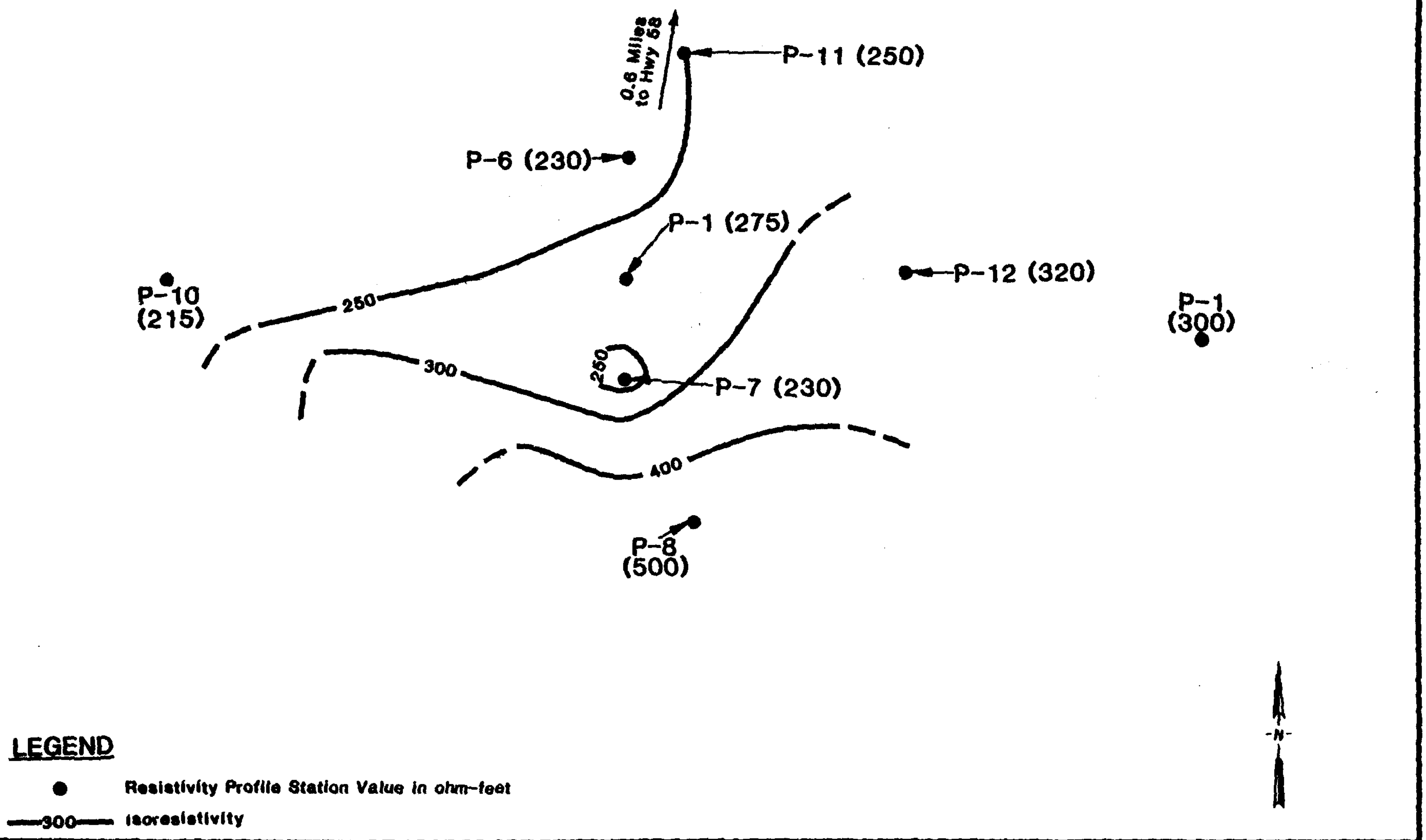
ELECTRICAL RESISTIVITY PROFILE MAP
SITES 1A & 1E
(Electrode Spacing of 50 feet)



ENGINEERING-SCIENCE

EDWARDS AFB

ELECTRICAL RESISTIVITY PROFILE MAP
SITES 1A & 1E
(Electrode Spacing of 100 feet)



ES ENGINEERING-SCIENCE

northwest trend of lower values is present. One hundred feet deep would be the zone just above the water table. The map at 150 feet (Figure I.7) indicates a more significant resistivity anomaly in the vicinity of Subsite 1A. The 150 and 200 ohm-feet isoresistivity contours show the approximate limits of the anomalies. These anomalies are interpreted as either geological in nature (i.e. clay lense) or groundwater contamination at the water table.

Subsites 1B, 1C and 1D - Magnetic Survey

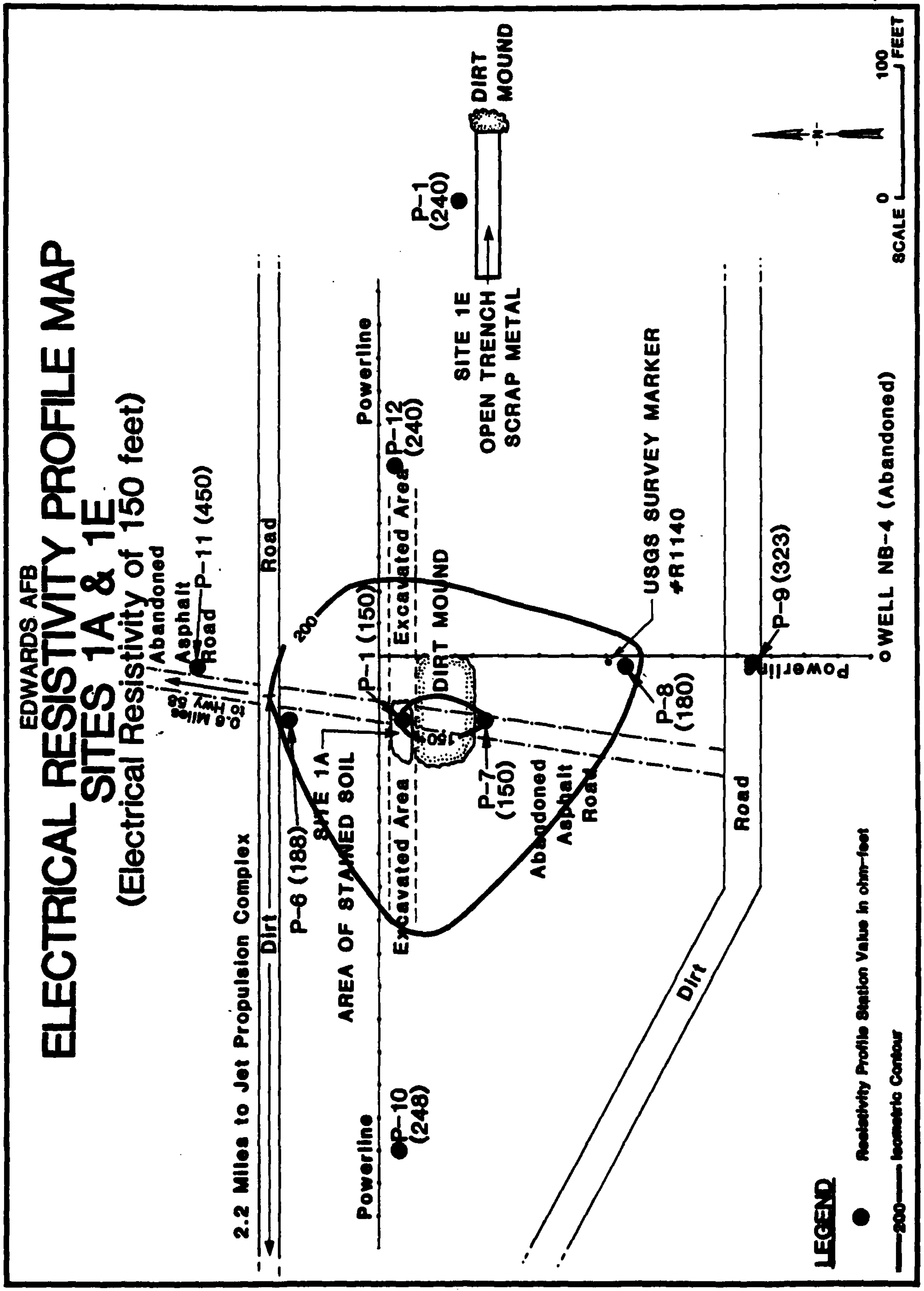
The magnetic survey of Subsites 1B, 1C and 1D did not indicate any areas of buried steel drums, other than those areas visible at Subsite 1D. Magnetometer background values ranged from 49,932 to 49,935 gammas. The magnetometer values in the immediate vicinity of Subsites 1B, 1C and 1D were consistent with the background values.

Subsites 1B, 1C AND 1D - Resistivity Survey

The resistivity survey at Subsites 1B, 1C and 1D consisted of both soundings and profiles. Figure I.8 shows the location of four soundings conducted at these sites. Figure I.9 through I.12 are graphs of the soundings and correlations of existing well log data. Figures I.9, I.10 and I.11 illustrate 30-foot soundings within each of the acid pits at Subsite IC. The relative resistivity values of sounding number 1 were significantly lower than those values for sounding numbers 2 and 3. These lower values of sounding number 1 are interpreted to indicate a larger volume of contaminants disposed of in the eastern pit. The larger volume probably also infiltrated to a deeper depth into the subsurface at the eastern pit. Sounding number 4 (Figure I.12) was conducted to a depth of 150 feet. Good correlation was established above 24 feet deep, but below 24 feet the sounding curve is depressed due to the influence of the very high levels of NO_3-N contaminants as reported in previous Phase II IRP reports.

The profile measurements obtained at Subsites 1B, 1C and 1D consisted of profiles at electrode spacings of 10, 30, 50, 100 and 150 feet. Figures I.13 thru I.17 illustrate the resistivity profile data gathered at the sites. The profile map at 10 feet (Figure I.13) indicates a variation of the resistivity measurements. Low values were

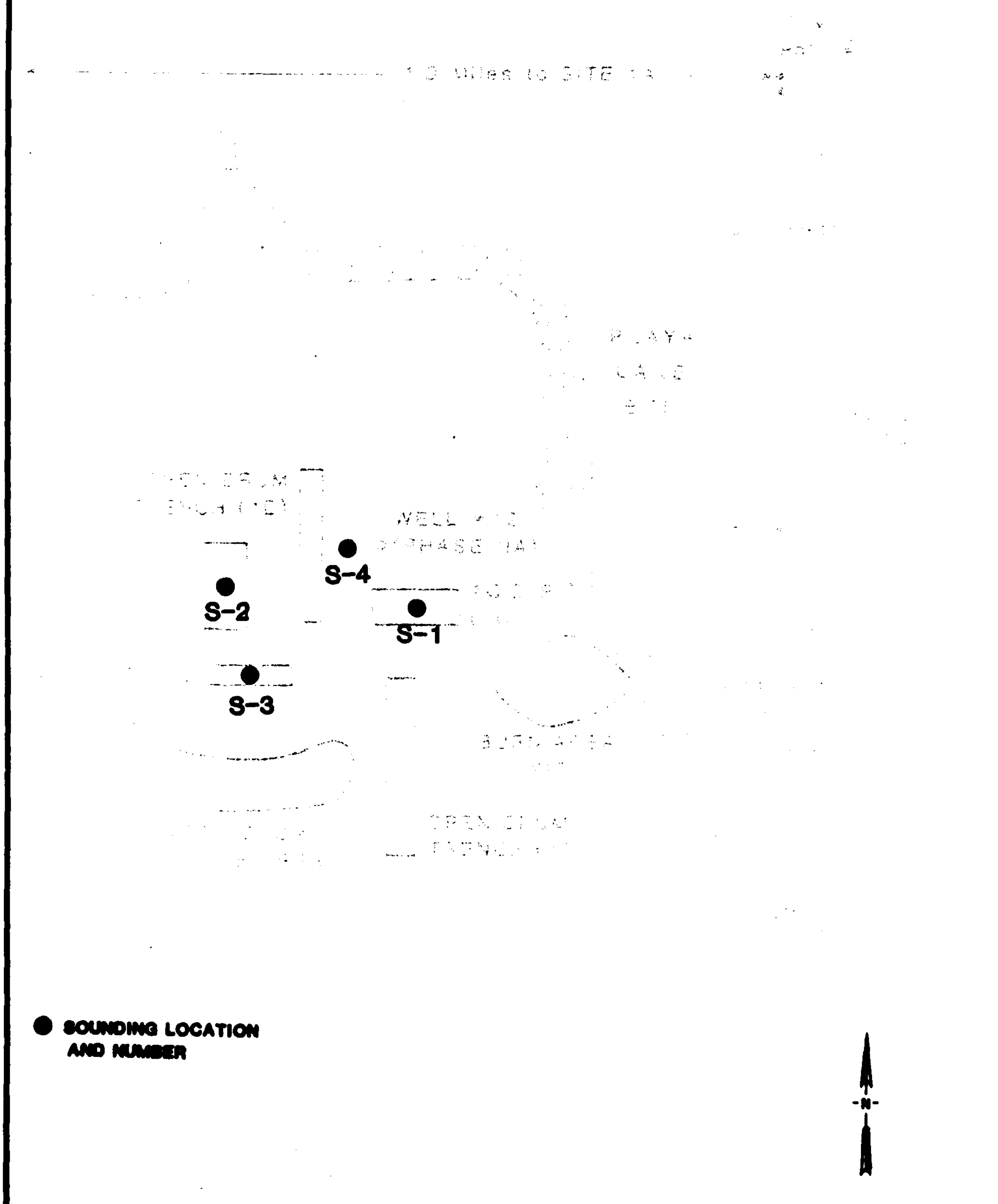
FIGURE I.7



EDWARDS AFB
ELECTRICAL RESISTIVITY PROFILE MAP
SITES 1A & 1E
(Electrical Resistivity of 150 feet)
2.2 Miles to Jet Propulsion Complex
Dirt
Road
0.6 Miles to Hwy 58
Abandoned Asphalt Road
P-11 (450)
P-6 (188)
SITE 1A
AREA OF STAINED SOIL
Excavated Area
Excavated Area
P-1 (150)
P-12 (240)
DIRT MOUND
200
150
P-7 (150)
P-8 (180)
Abandoned Asphalt Road
USGS SURVEY MARKER #R1140
Road
Dirt
P-9 (323)
Powerline
Powerline
Powerline
P-10 (248)
WELL NB-4 (Abandoned)
SITE 1E
OPEN TRENCH
SCRAP METAL
P-1 (240)
DIRT MOUND
N
SCALE 0 100 FEET
LEGEND
Resistivity Profile Station Value in ohm-feet
200 Isometric Contour

EDWARDS AFB

LOCATIONS OF RESISTIVITY SOUNDINGS SITES 1B, 1C, 1D



ENGINEERING-SCIENCE

FIGURE I.9

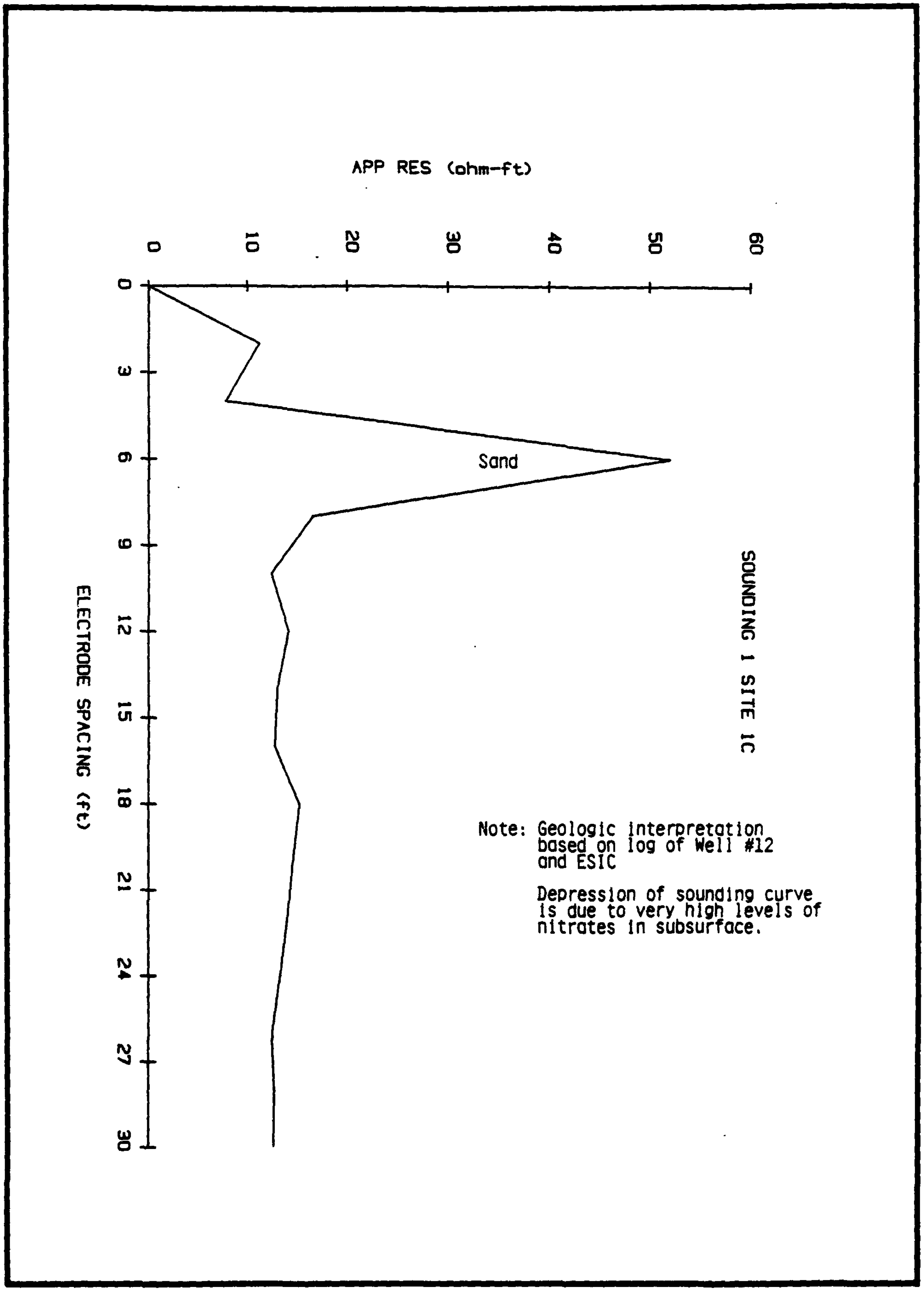
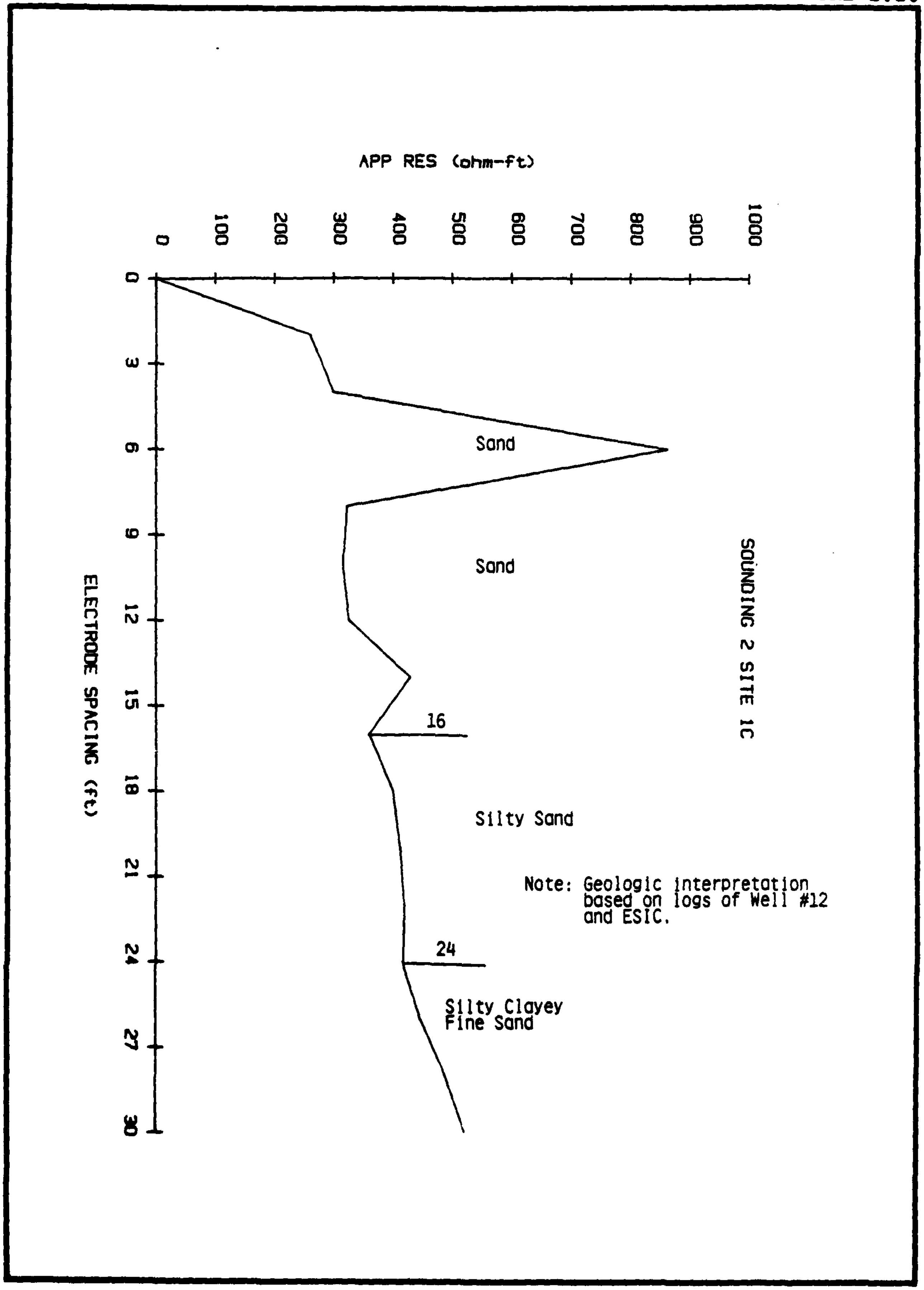
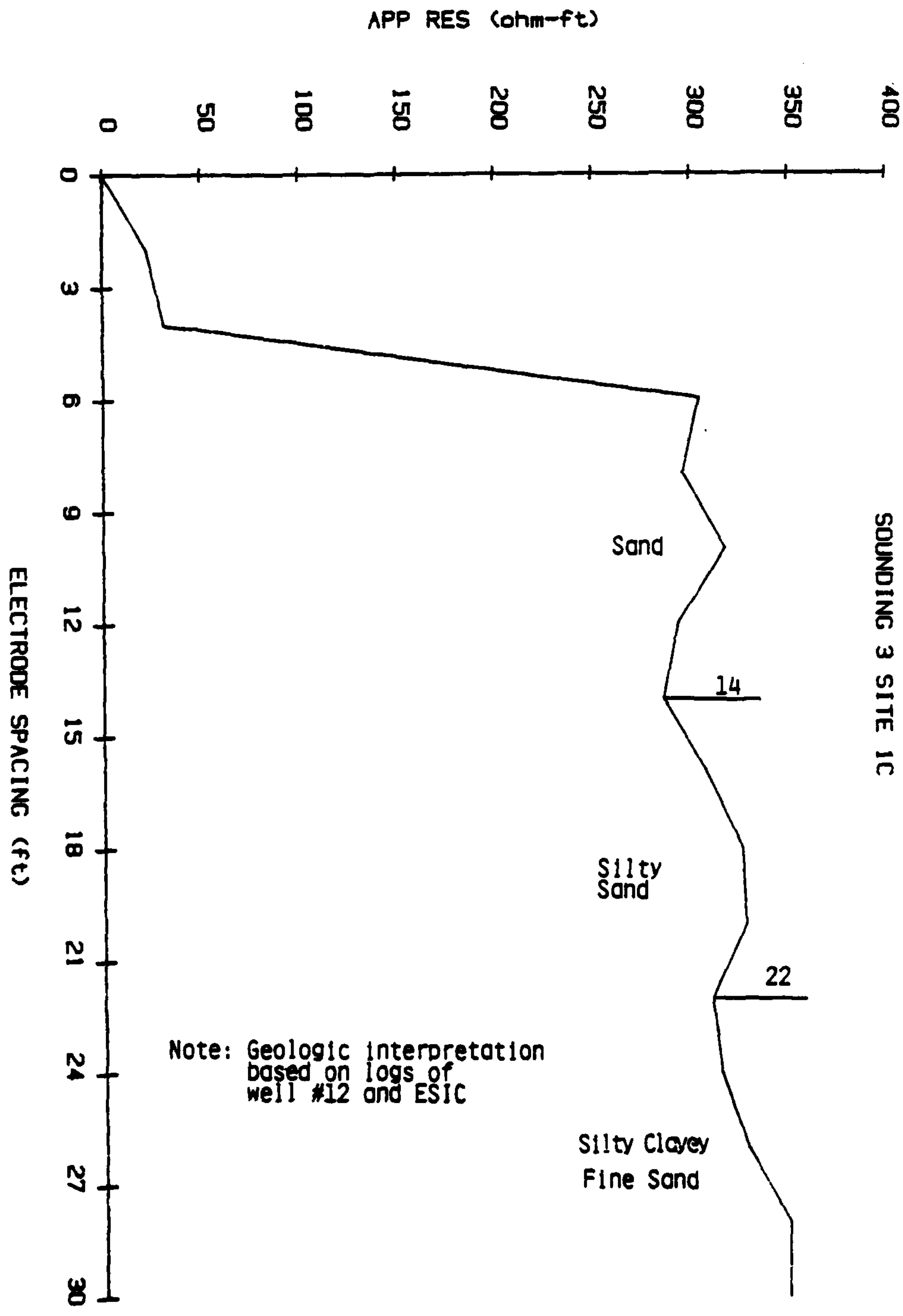

SOUNDING 1 SITE 1C
APP RES (ohm-ft)
0
10
20
30
40
50
60
ELECTRODE SPACING (ft)
0
3
6
9
12
15
18
21
24
27
30
Sand
Note: Geologic interpretation based on log of Well #12 and ESIC
Depression of sounding curve is due to very high levels of nitrates in subsurface.

FIGURE I.10



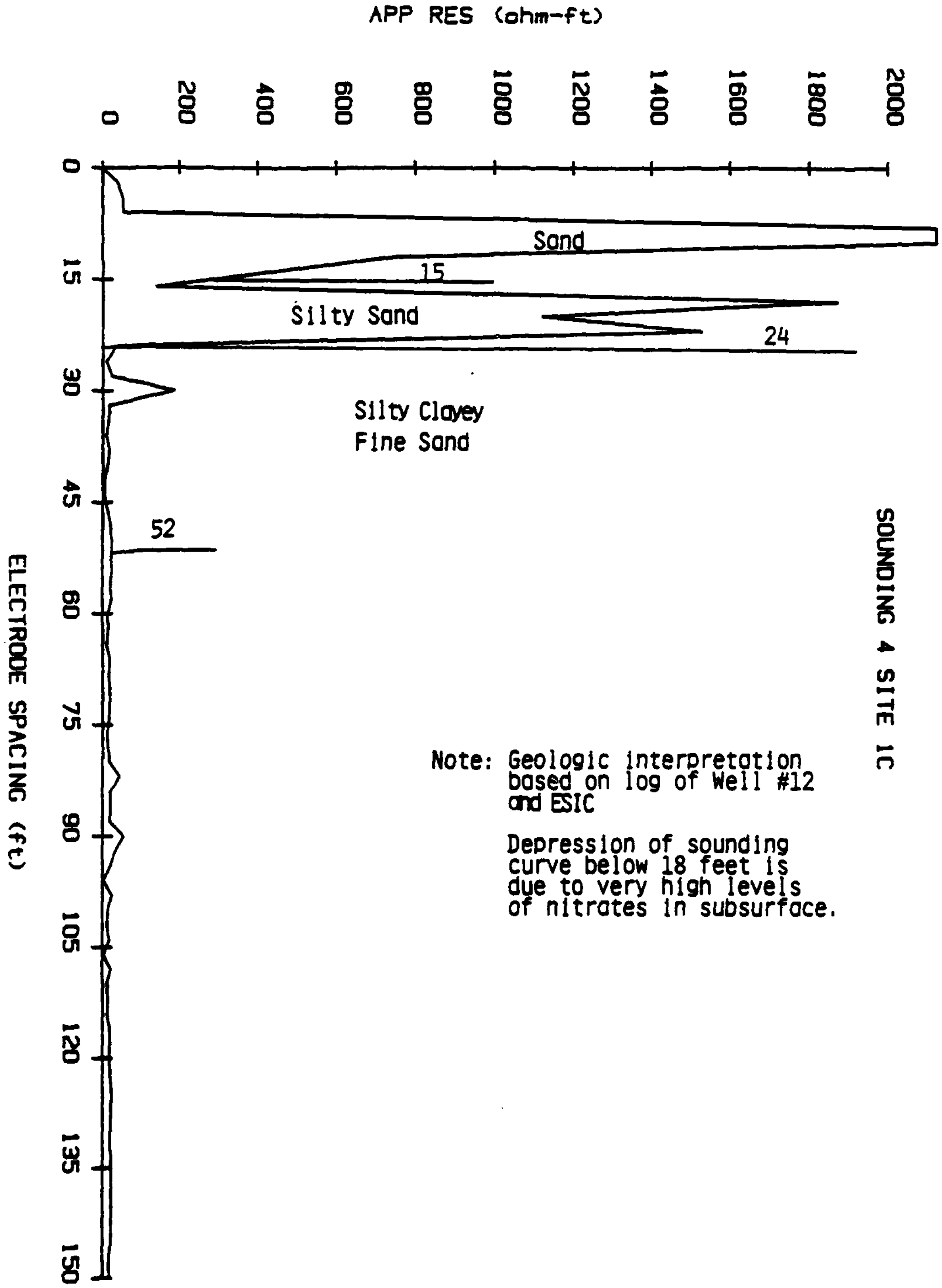
APP RES (ohm-ft)
0
100
200
300
400
500
600
700
800
900
1000
0
3
6
9
12
15
18
21
24
27
30
ELECTRODE SPACING (ft)
SOUNDING 2 SITE 1C
Sand
Sand
16
Silty Sand
24
Silty Clayey
Fine Sand
Note: Geologic interpretation
based on logs of Well #12
and ESIC.

FIGURE I.11



APP RES (ohm-ft)
0
50
100
150
200
250
300
350
400
SOUNDING 3 SITE 1C
0
3
6
9
12
15
18
21
24
27
30
ELECTRODE SPACING (ft)
Sand
14
Silty
Sand
22
Silty Clayey
Fine Sand
Note: Geologic interpretation
based on logs of
well #12 and ESIC

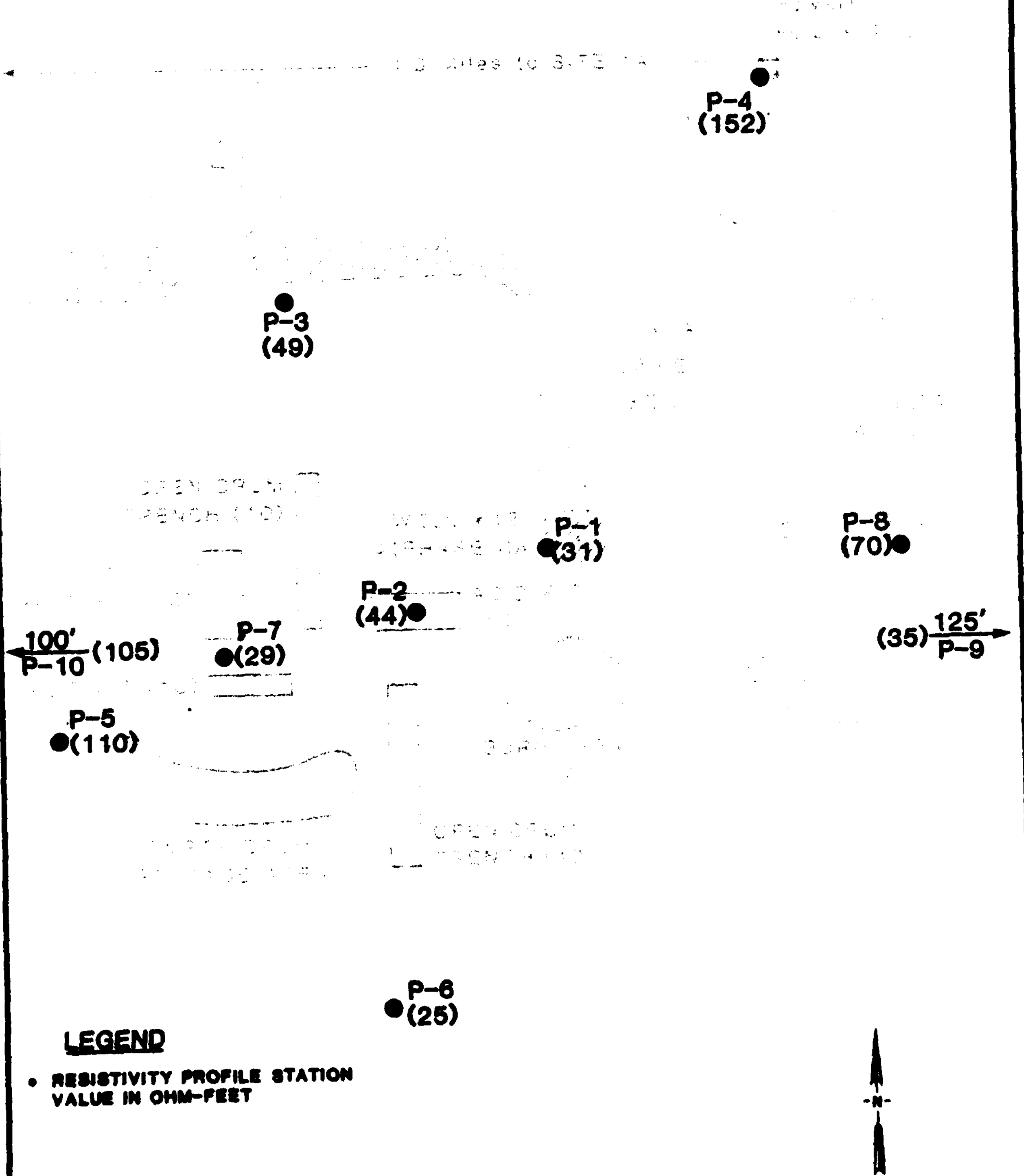
FIGURE I.12


SOUNDING 4 SITE 1C
APP RES (ohm-ft)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
ELECTRODE SPACING (ft)
0
15
30
45
60
75
90
105
120
135
150
Sand
15
Silty Sand
24
Silty Clayey Fine Sand
52
Note: Geologic interpretation based on log of Well #12 and ESIC
Depression of sounding curve below 18 feet is due to very high levels of nitrates in subsurface.

EDWARDS AFB

ELECTRICAL RESISTIVITY PROFILE MAP SITES 1B, 1C, 1D

(Electrode Spacing of 10 feet)



ENGINEERING-SCIENCE

obtained both in the site area and outside the site area. These values indicate probable geologic anomalies as well as anomalies associated with contaminants. The profile map at 30 feet (Figure I.14) indicates a more identifiable resistivity anomaly within the immediate vicinity of the acid pits. This anomaly is interpreted as contaminated soil. The profile map at 50 feet (Figure I.15) indicates a larger anomaly trending west, north and south of the acid pit area. This anomaly is also interpreted as a clay lense as indicated on the boring log for well No.12. The profile map at 100 feet (Figure I.16) indicates an even larger anomaly trending both north and south of the site area. The values at stations P-8 and P-9, east of the sites, although similar in value to stations P-6 and P-7 are interpreted as geologic anomalies associated with the playa lake deposits rather than anomalies associated with subsurface contamination. The profile map at 150 feet indicates relatively low values at the site and southwest of the site. A resistivity anomaly in the northward direction, which is the ground-water flow direction, is not indicated by the data.

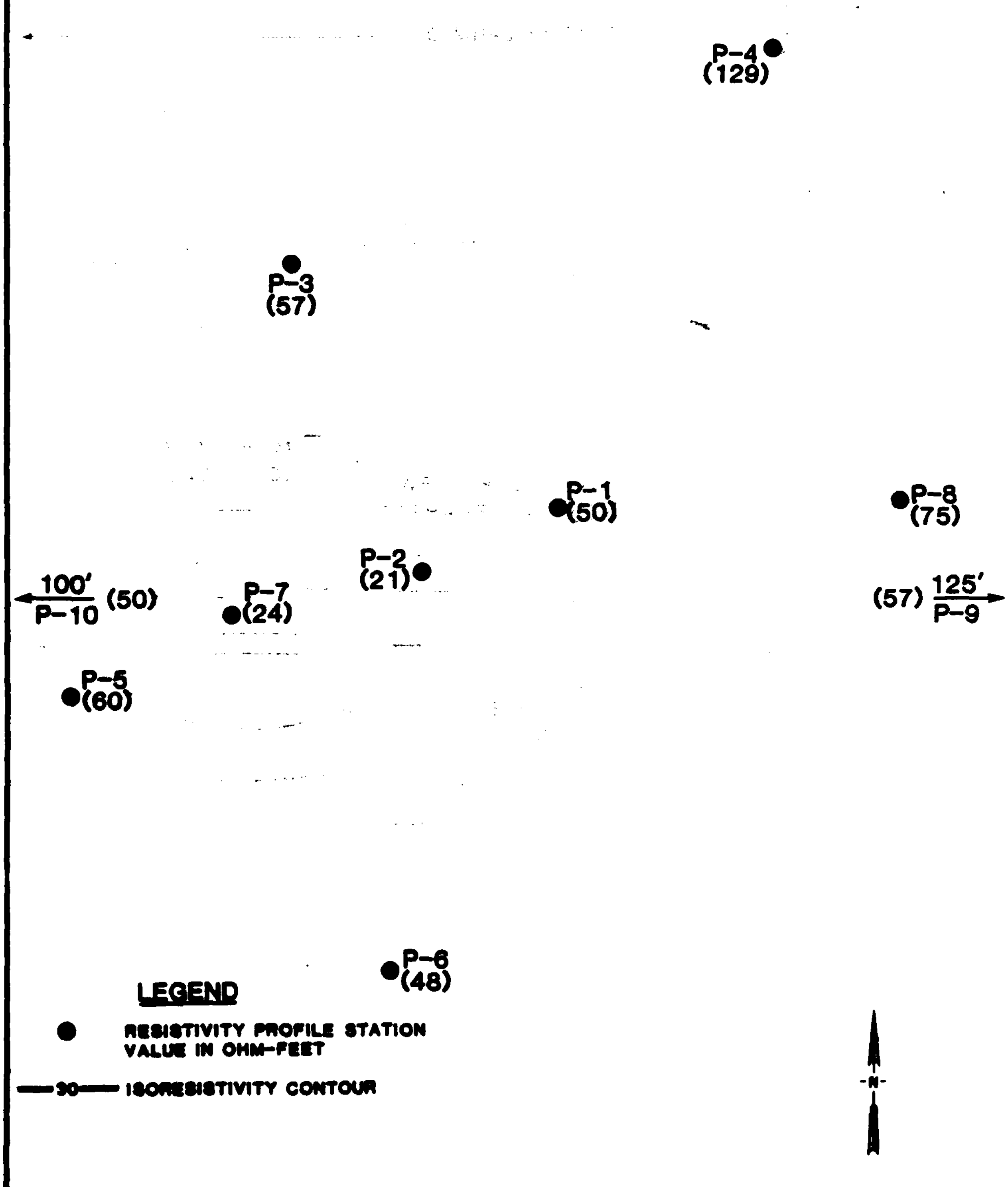
Site 2 - Magnetic Survey

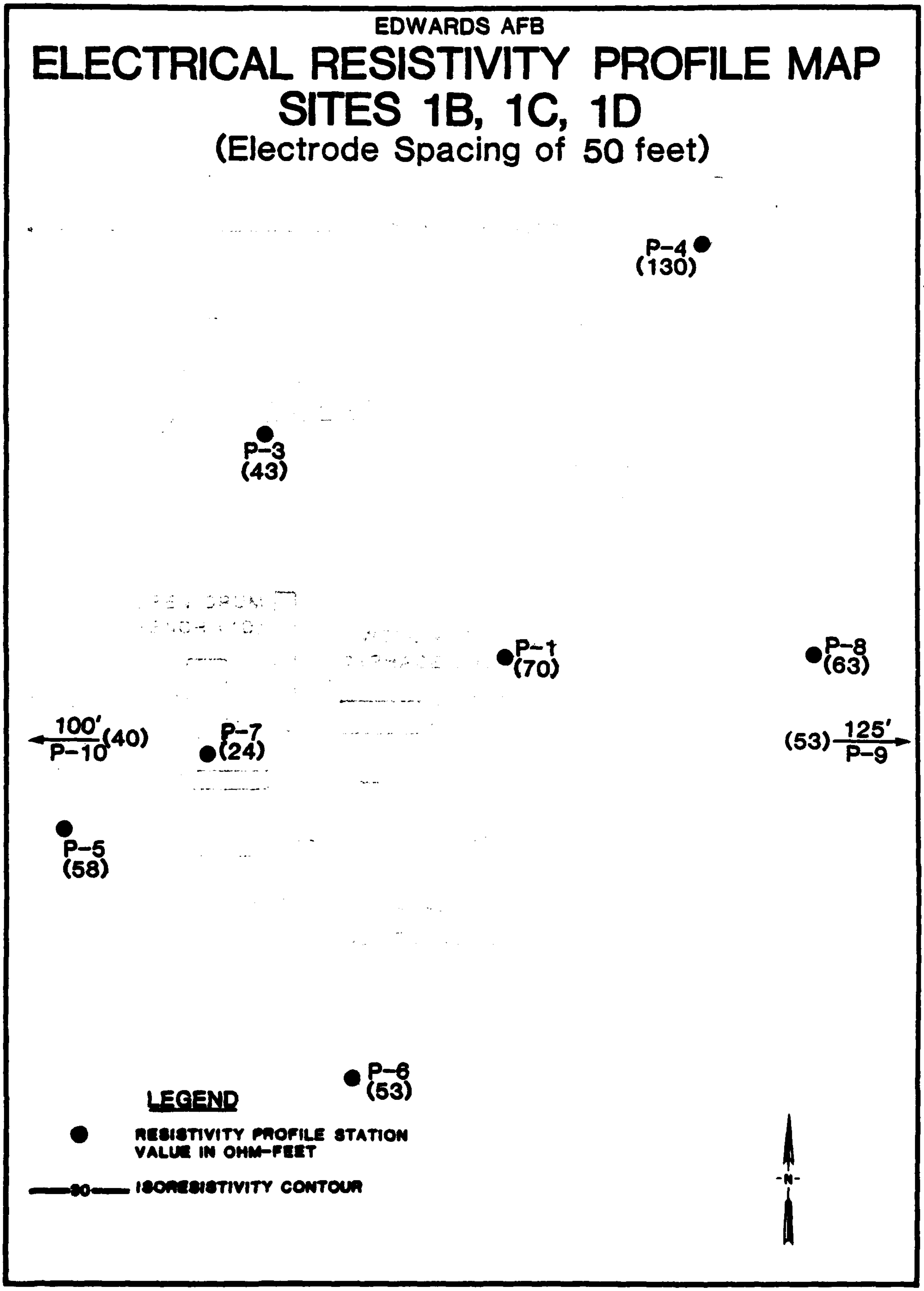
The magnetic survey at Site 2 consisted of a 20-foot grid system covering the entire fenced-in area. Magnetometer measurements were obtained at every station within the fence and selected locations outside the fence. During the field survey, magnetic storms within the atmosphere interfered with the magnetic survey. These magnetic storms distorted the otherwise naturally existing magnetic field at Site 2. Magnetic storms are caused by cosmic explosions on the sun and/or large electrical thunderstorms. During the magnetic storms, the magnetic survey was terminated. Once a natural background magnetometer measurement was obtained, the survey was continued. The background values on April 29, 1984 and April 30, 1984 varied from 49,951 to 49,977 gammas. The magnetic survey on these two days consisted of magnetometer traverses over the suspected pit areas generally identified during the overall magnetometer survey. Figure I.18 illustrates the location of 17 pits within Site 2 as determined by the magnetic survey. Magnetometer traverses were conducted over each of the pits. The traverses illustrate the natural magnetometer measurements outside each pit and

EDWARDS AFB

ELECTRICAL RESISTIVITY PROFILE MAP SITES 1B, 1C, 1D

(Electrode Spacing of 30 feet)

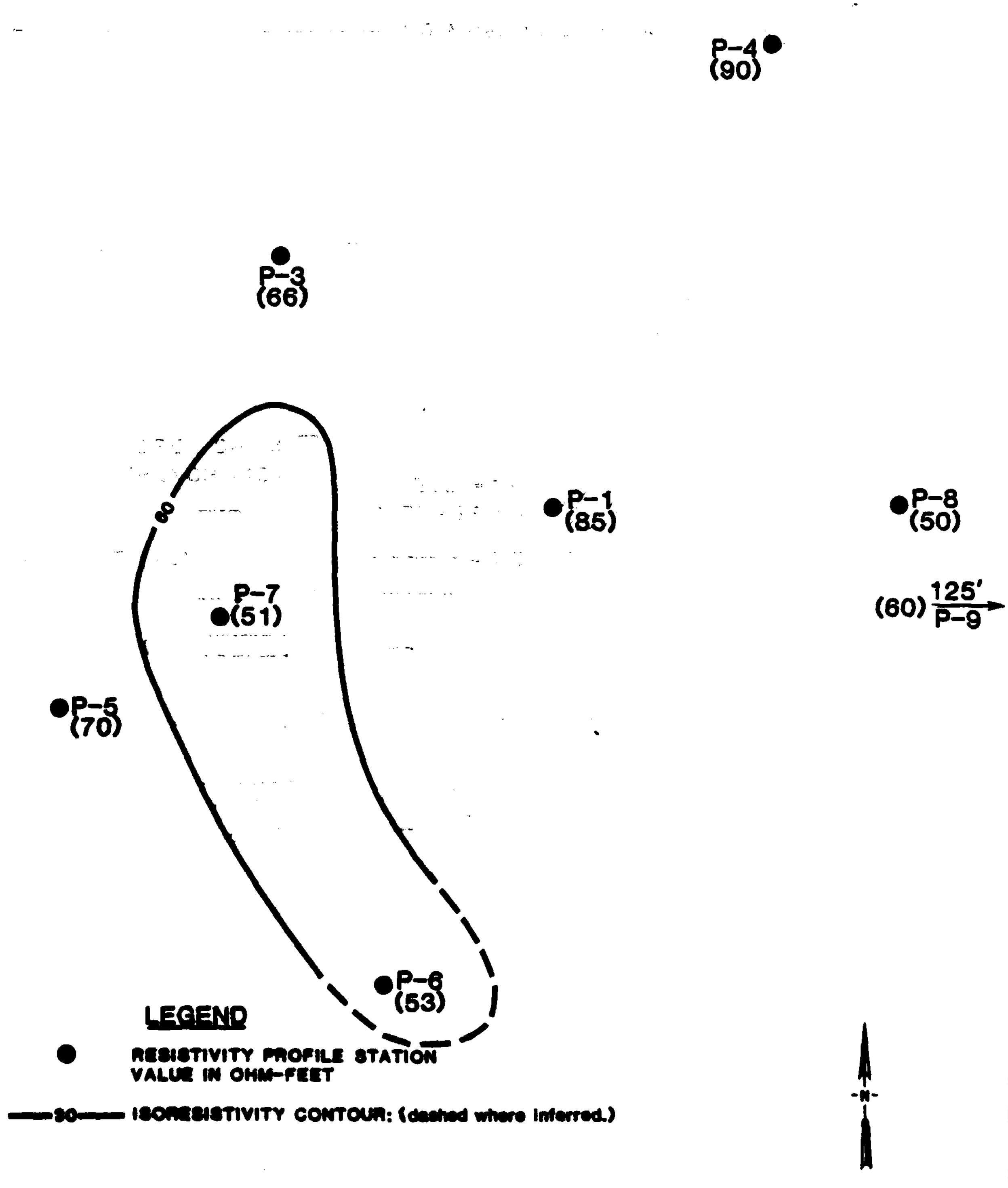



EDWARDS AFB
ELECTRICAL RESISTIVITY PROFILE MAP
SITES 1B, 1C, 1D
(Electrode Spacing of 50 feet)
P-4 (130)
P-3 (43)
P-1 (70)
P-8 (63)
100′ P-10 (40)
P-7 (24)
(53) 125′ P-9
P-5 (58)
P-6 (53)
LEGEND
RESISTIVITY PROFILE STATION
VALUE IN OHM-FEET
90 ISORESISTIVITY CONTOUR
-N-

EDWARDS AFB

ELECTRICAL RESISTIVITY PROFILE MAP SITES 1B, 1C, 1D

(Electrode Spacing of 100 feet)



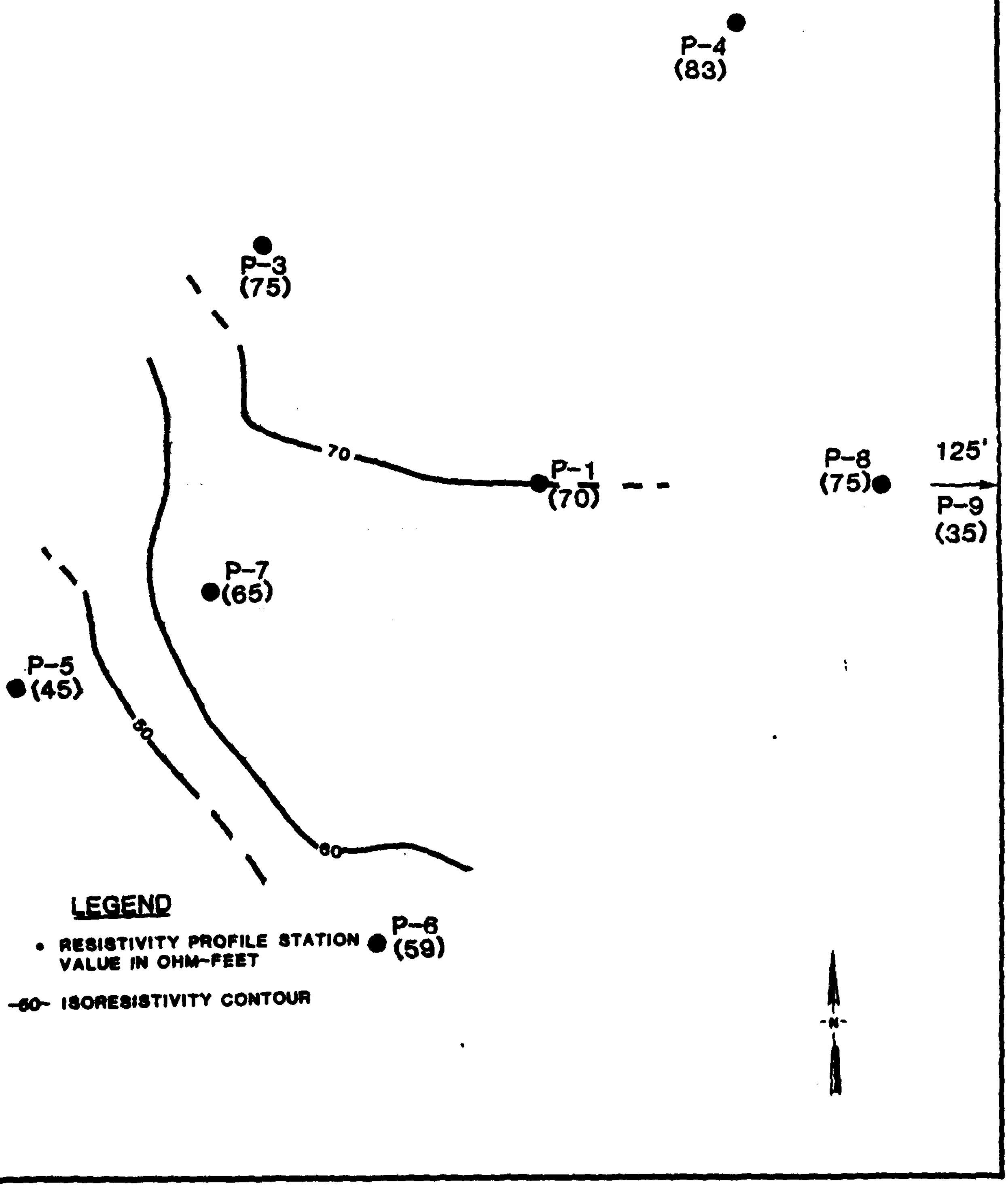
E. NGINEERING-SCIENCE

FIGURE I.17

EDWARDS AFB

ELECTRICAL RESISTIVITY PROFILE MAP SITES 1B, 1C, 1D

(Electrode Spacing of 150 feet)

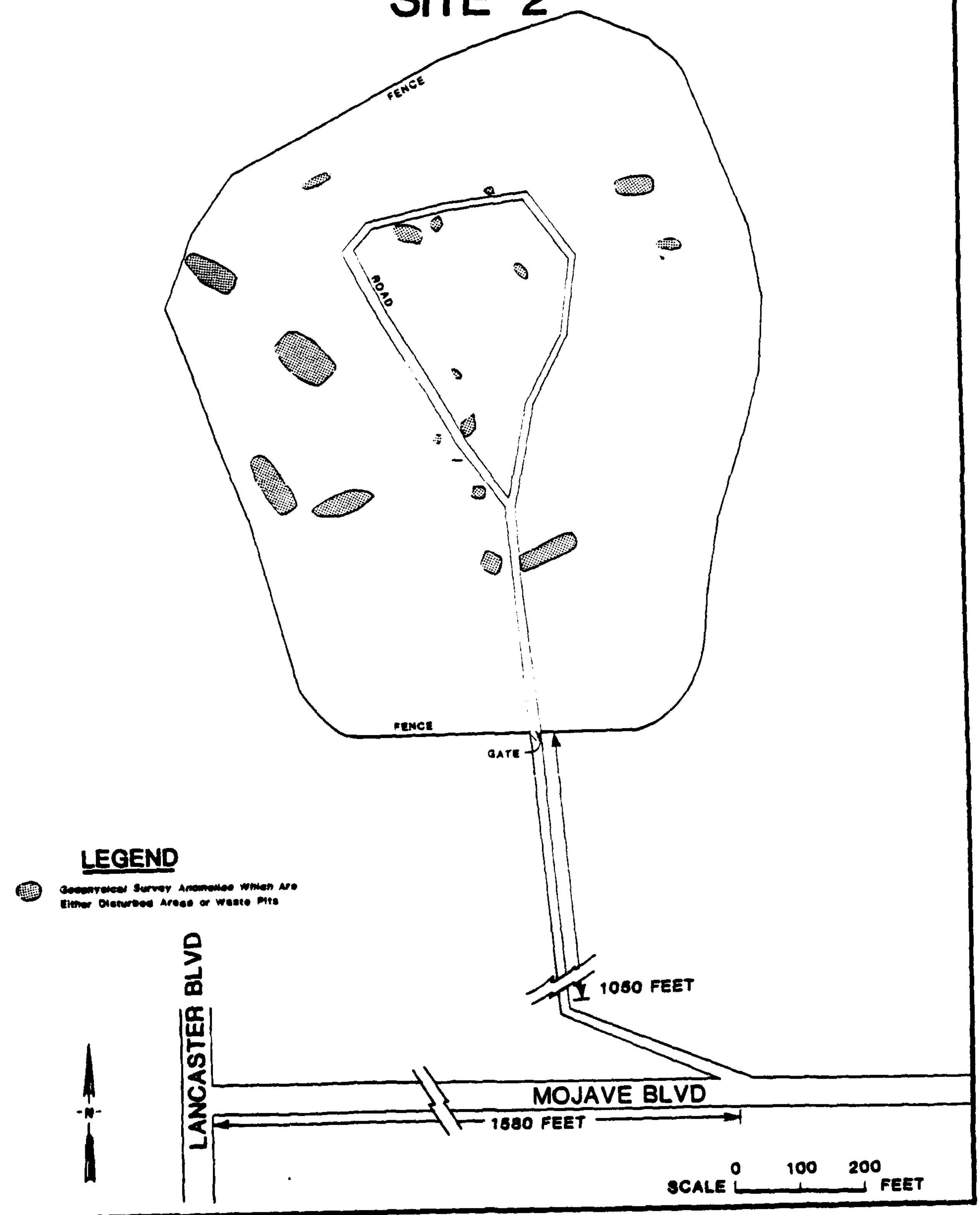


ES ENGINEERING-SCIENCE

FIGURE I.18

EDWARDS AFB

RELATIVE LOCATION OF WASTE PITS BASED ON MAGNETOMETER SURVEY SITE 2



the relatively high magnetometer measurements in the center of each pit. The magnetometer values which were recorded in the center of the pits are interpreted as representing disturbed soil zones. The values are not indicative of a large number of steel drums buried in the pits. The approximate depth to the top of the magnetic anomaly (disturbed soil and/or containers) was calculated for each pit using the "Slope Technique" as described by Breiner, 1973. In this technique, the horizontal distance between the inflection points of a straight line, drawn along the slope of the magnetic anomaly graph, is approximately equal to the depth to the top of the magnetic anomaly. The depths to the anomalies within the Site 2 pits varied from 5 to 19 feet.

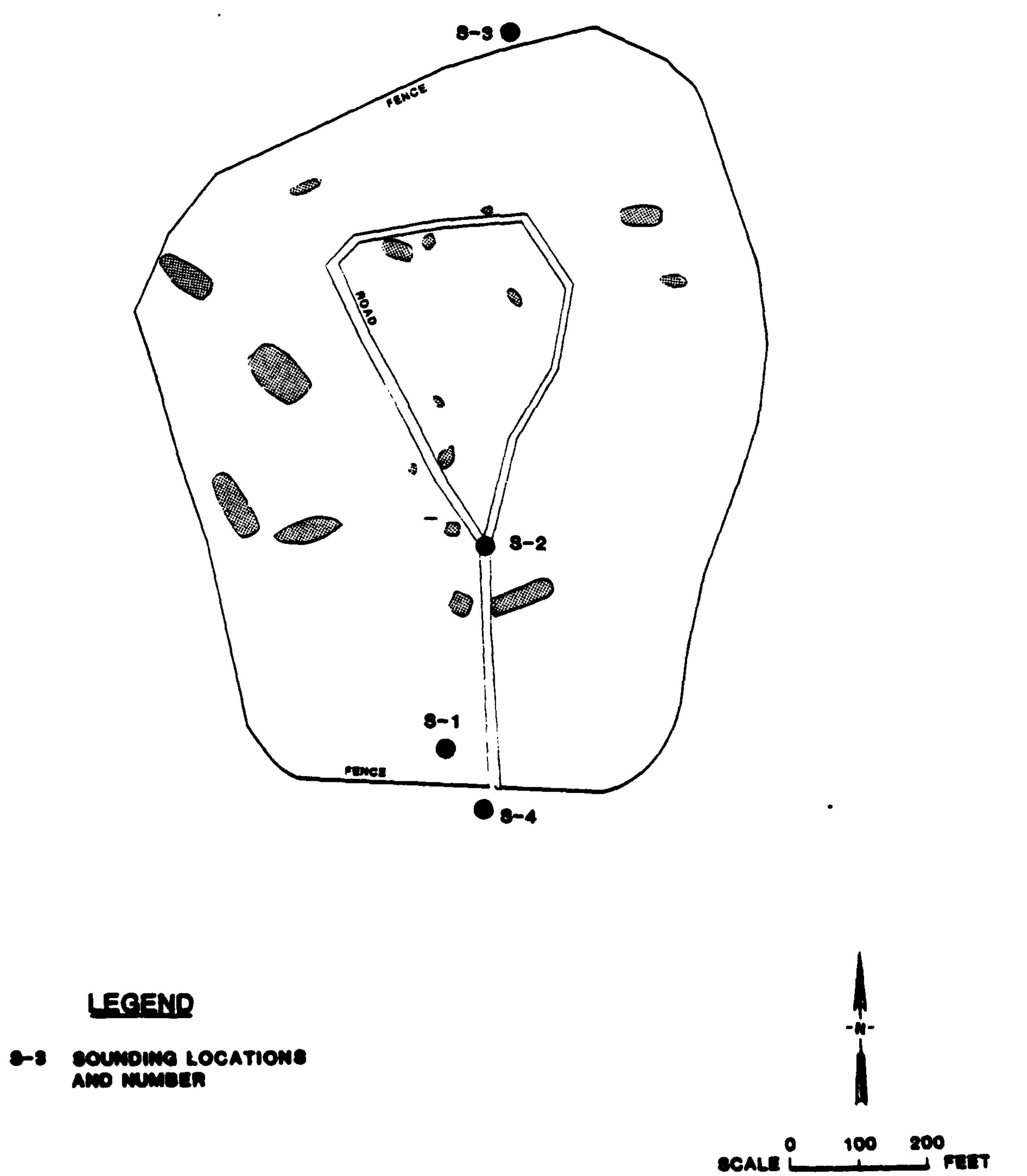
Site 2 - Resistivity Survey

The resistivity survey at Site 2 consisted of both soundings and profiles. Figure I.19 shows the locations of the four soundings conducted at Site 2. Figures I.20 through I.23 are graphs of each of the soundings and correlations of existing bore hole data. Good geologic correlation was established at each of the soundings. A sand and gravel zone exists to a depth of 5 to 6 feet. Underlying the sand and gravel is a zone of weathered bedrock to a depth of 21 to 30 feet deep below which solid bedrock was interpreted. The graphs of sounding numbers 2 and 4 (Figures I.20 and I.23) indicate the presence of bedrock possibly containing fractures. Bedrock without fractures is interpreted to exist below depths of 68 feet on sounding number 2 and 84 feet on sounding number 4. The fractures as interpreted do not indicate the presence of ground water although seasonal water may be present. Sounding data (Figures I.20 and I.23) has been affected by potential contaminants in soils thereby decreasing the stratigraphic details that can be interpreted.

The profiles at Site 2 consisted of electrode spacings of 5, 10, 20 and 50 feet. These zones were chosen to correspond to the geologic zones as interpreted from the soundings. Figures I.24 through I.27 are profile maps of Site 2. The profile map at 5 feet (Figure I.24) indicates an anomaly trending northwest-southeast and extending outside the southern most fence. This anomaly is interpreted as contaminated soil. The profile map at 10 feet (Figure I.25) indicates a similar anomaly

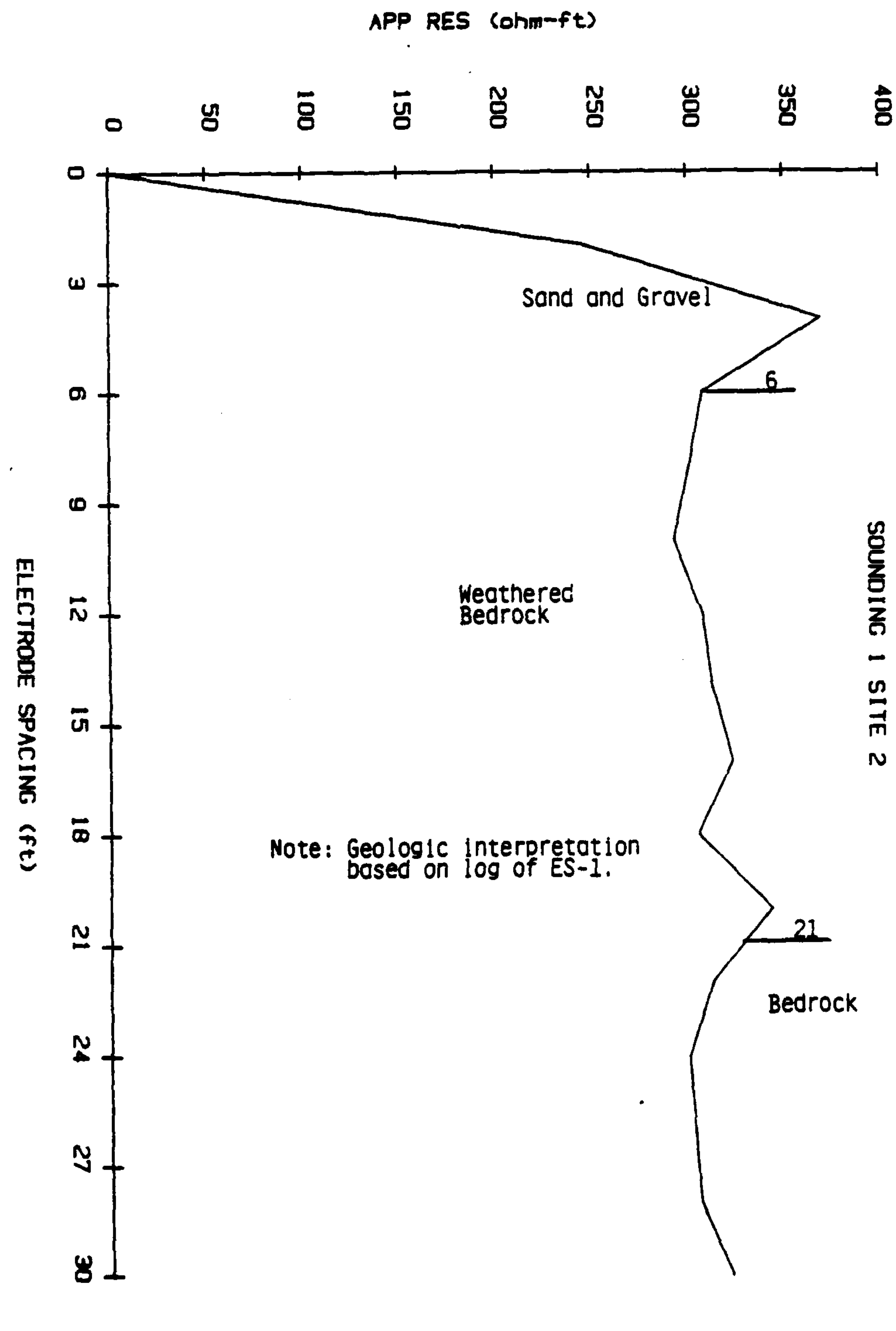
FIGURE I.19

EDWARDS AFB
LOCATION OF RESISTIVITY SOUNDINGS SITE 2



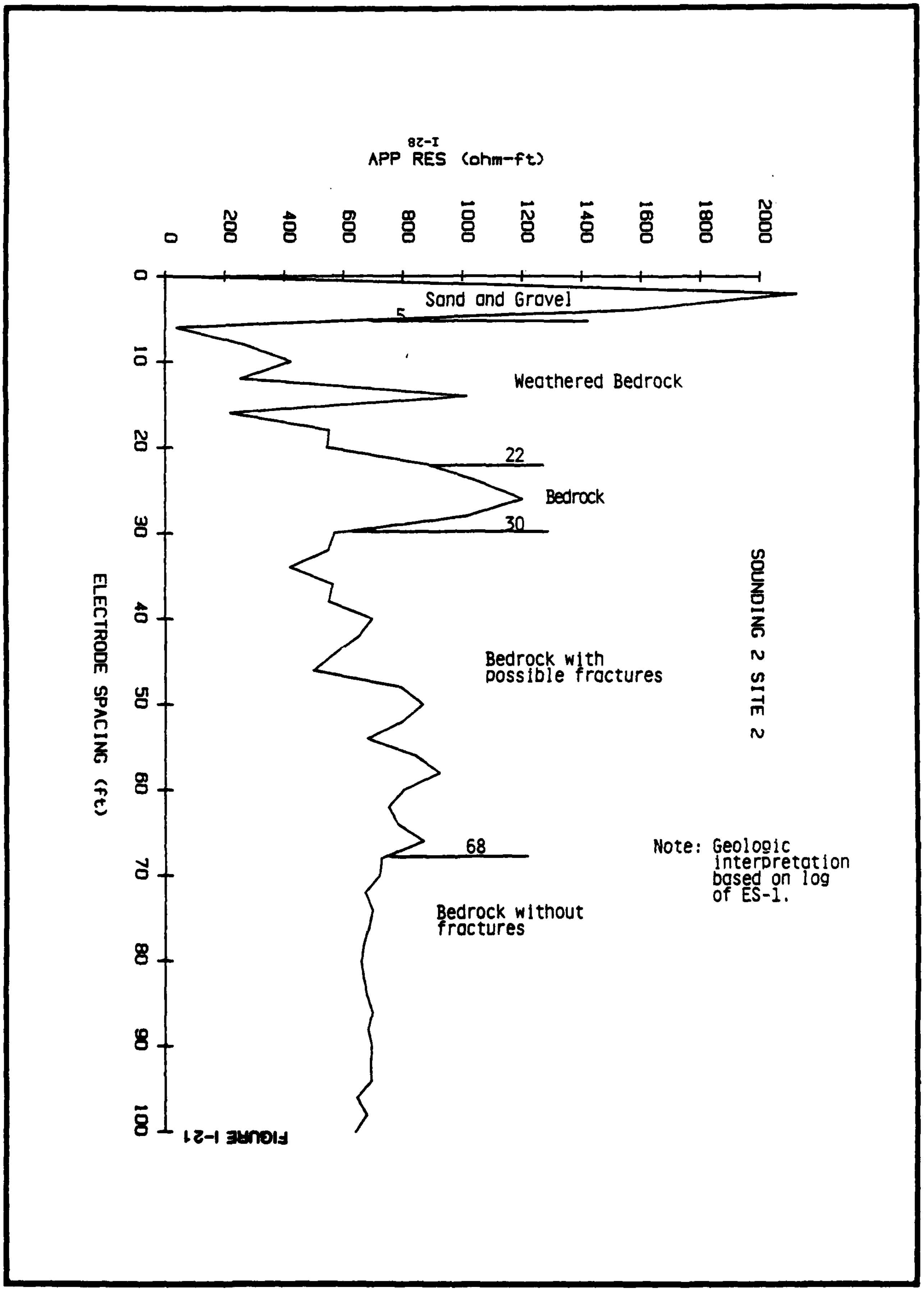
ES ENGINEERING-SCIENCE

FIGURE I.20



SOUNDING 1 SITE 2
APP RES (ohm-ft)
0
50
100
150
200
250
300
350
400
ELECTRODE SPACING (ft)
0
3
6
9
12
15
18
21
24
27
30
Sand and Gravel
6
Weathered Bedrock
Note: Geologic interpretation based on log of ES-1.
21
Bedrock

FIGURE I.21



I-28
APP RES (ohm-ft)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
ELECTRODE SPACING (ft)
0
10
20
30
40
50
60
70
80
90
100
Sand and Gravel
5
Weathered Bedrock
22
Bedrock
30
Bedrock with possible fractures
68
Bedrock without fractures
SOUNDING 2 SITE 2
Note: Geologic interpretation based on log of ES-1.
FIGURE I-21

FIGURE I.22

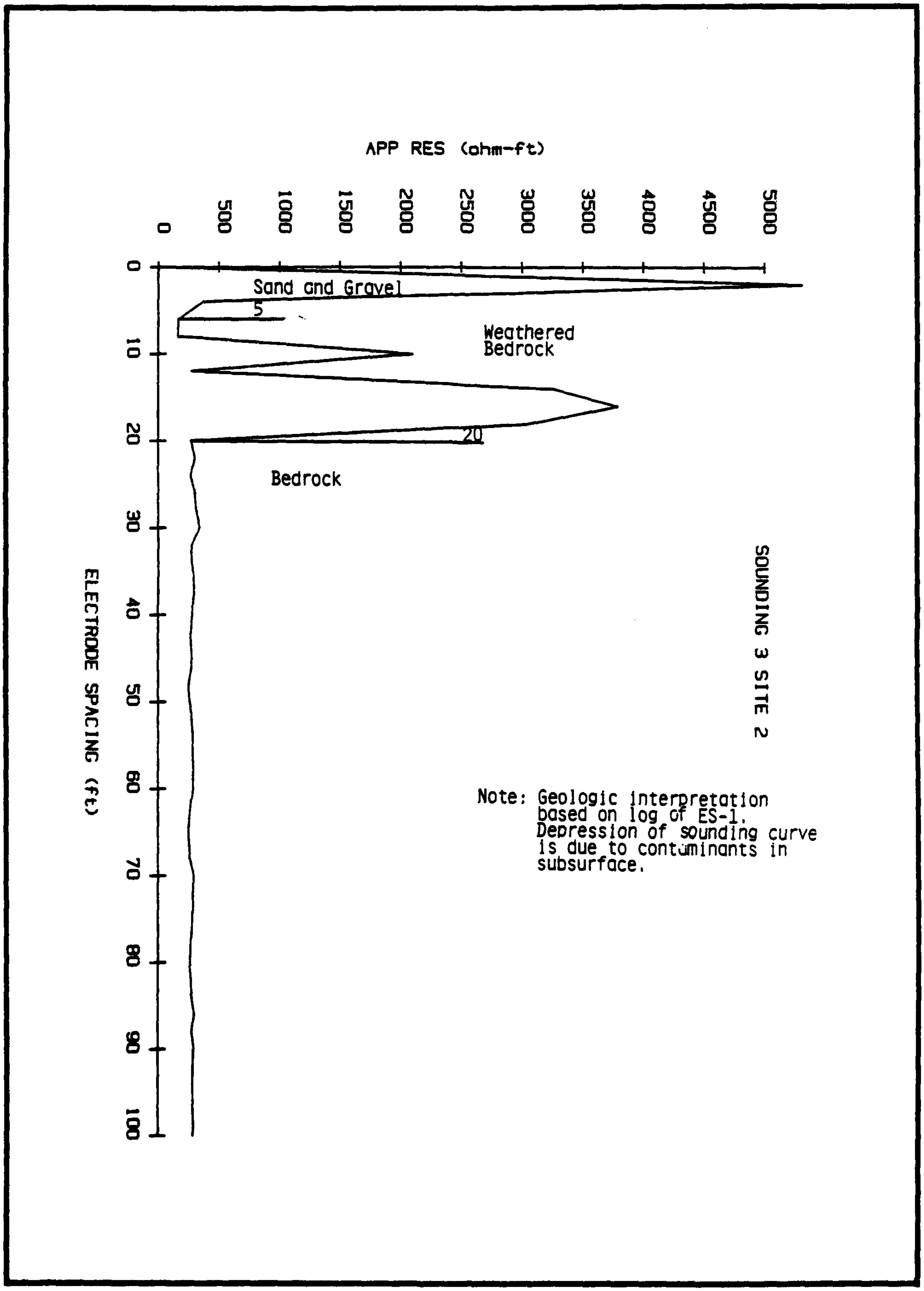
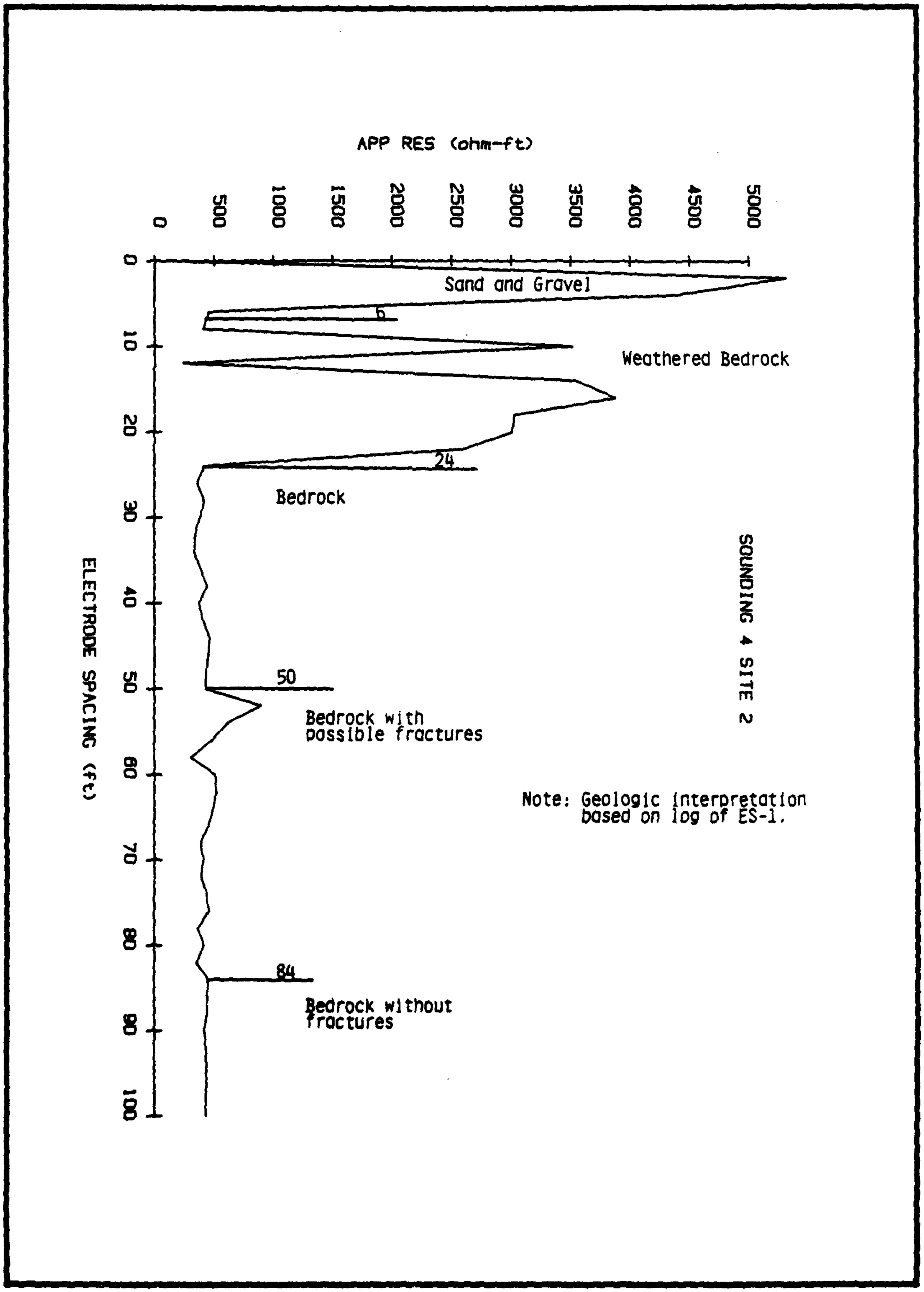

SOUNDING 3 SITE 2
APP RES (ohm-ft)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
ELECTRODE SPACING (ft)
0
10
20
30
40
50
60
70
80
90
100
Sand and Gravel
5
Weathered Bedrock
20
Bedrock
Note: Geologic interpretation based on log of ES-1. Depression of sounding curve is due to contaminants in subsurface.

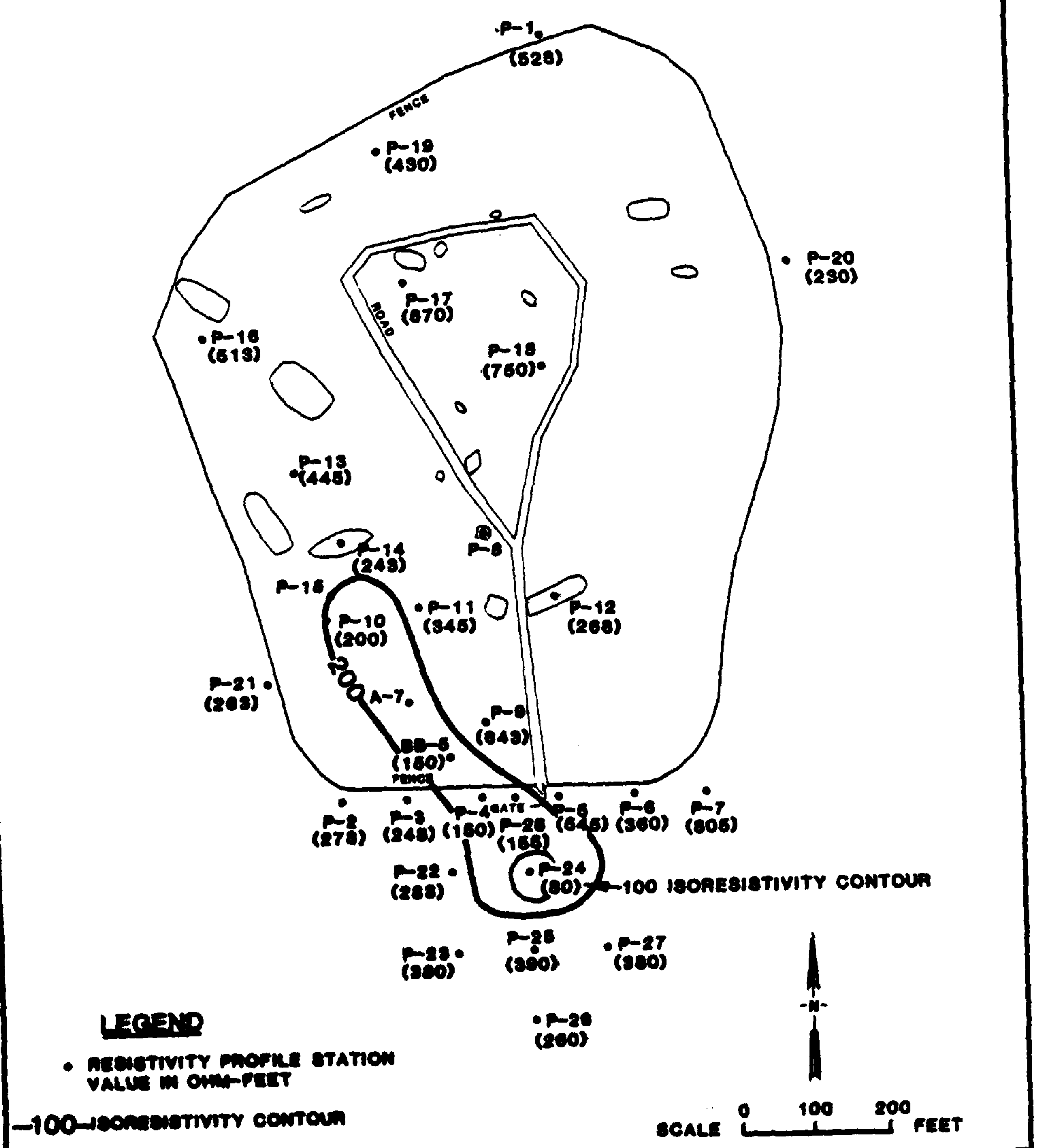
FIGURE I.23


APP RES (ohm-ft)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
ELECTRODE SPACING (ft)
0
10
20
30
40
50
60
70
80
90
100
Sand and Gravel
6
Weathered Bedrock
24
Bedrock
50
Bedrock with
possible fractures
84
Bedrock without
fractures
SOUNDING 4 SITE 2
Note: Geologic interpretation
based on log of ES-1.

EDWARDS AFB

ELECTRICAL RESISTIVITY PROFILE MAP SITE 2

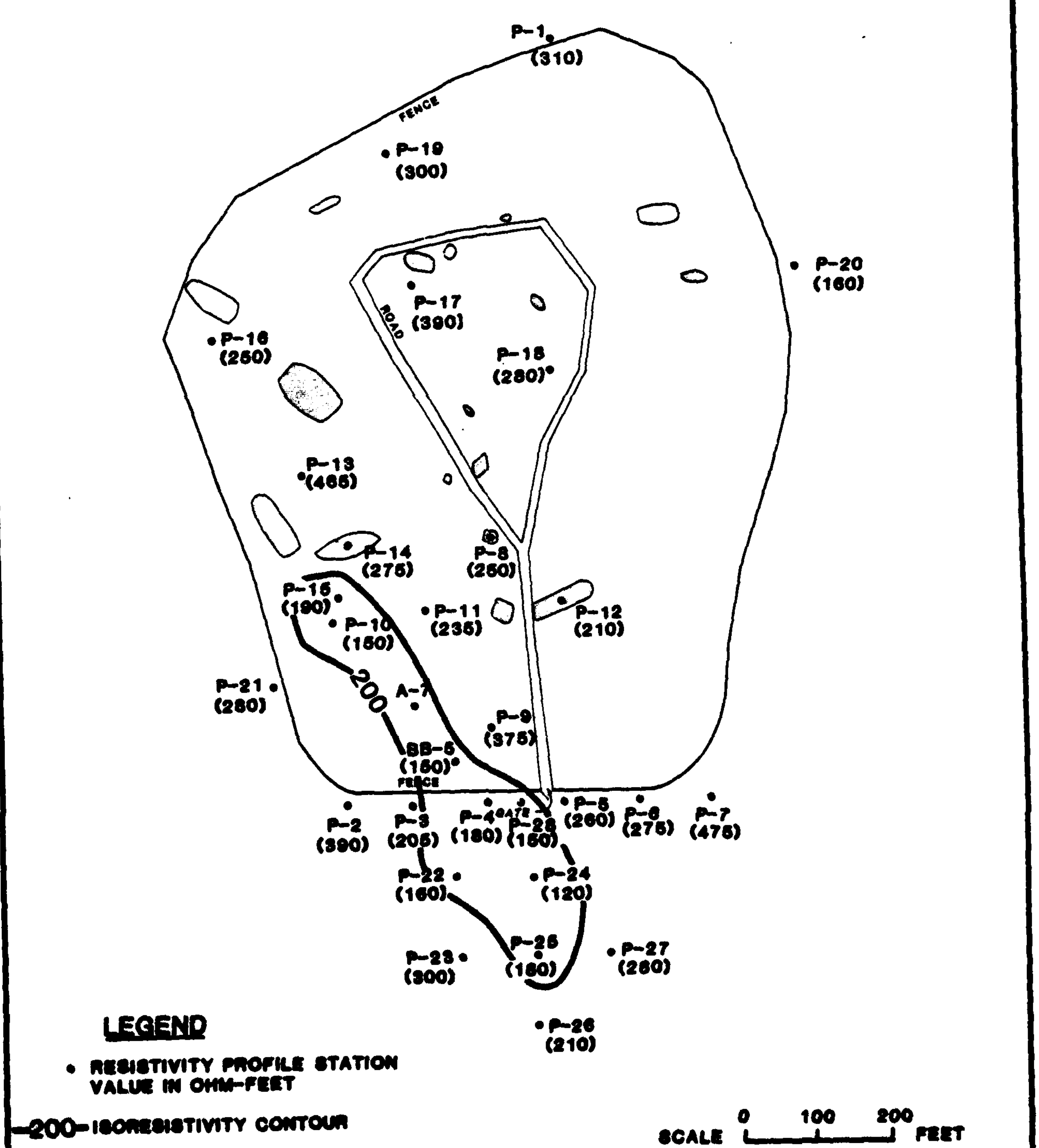
(Electrode Spacing of 5 feet)



ES ENGINEERING-SCIENCE

FIGURE I.25

EDWARDS AFB
ELECTRICAL RESISTIVITY PROFILE MAP SITE 2
(Electrode Spacing of 10 feet)



ENGINEERING-SCIENCE

south of the fence. This anomaly is also interpreted as contaminated soil. Note that the value at profile station P-20 northeast of the site is similar in value to the anomaly. The profile map at 20 feet (Figure I.26) also indicates a similar anomaly also interpreted as contaminated soil. Note that resistivity values within the anomaly are only slightly lower than values at stations P-1, P-20 and P-21 outside the fence. Contamination at these locations is suspected. The profile map at 50 feet (Figure I.27) does not indicate a significant anomaly. The electrode spacing (50 feet) for this profile map investigated into bedrock, hence the relatively consistent values. The lower values probably represent fractured bedrock while the higher values probably represent solid bedrock.

Summary

In summary, the geophysical survey field program consisted of both magnetic and resistivity surveys. The objectives were met by general and detail surveys at Subsites 1A, 1B, 1C, 1D, 1E and Site 2. At Subsite 1A no magnetic anomalies were identified, but resistivity anomalies did indicate either a geologic anomaly or contaminated ground water at the 150 foot depth. Due to the low level of contaminants identified in the soil columns at Subsite 1A it is expected that the anomoly is geologic in nature. At Subsite 1E a magnetic anomaly was identified south of the existing open trench, but no resistivity anomalies were identified. This material is likely scrap metal debris similar to the scrap metal located in open trench 1E. At Subsites 1B, 1C and 1D no magnetic anomalies were identified, but resistivity anomalies were identified. The resistivity anomalies are interpreted as contaminated soils and/or clay lenses. At Site 2 both magnetic and resistivity anomalies were identified. The magnetic anomalies are interpreted as excavated areas or waste pits and the resistivity anomalies are interpreted as contaminated soils and weathered bedrock.

SOIL SAMPLING AND ANALYSIS

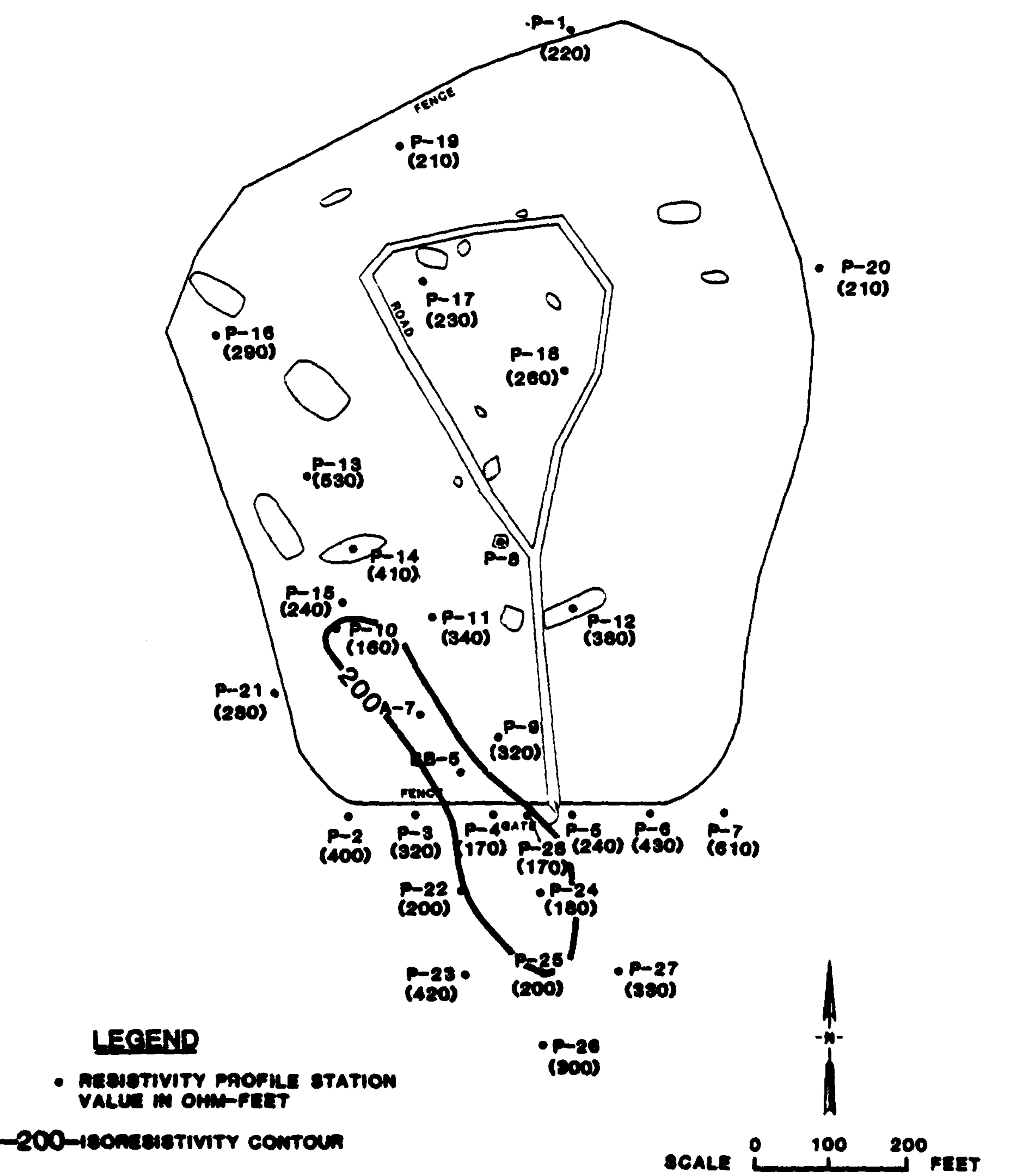
Supplemental soil sampling was conducted at Site 1 and Site 2 at Edwards AFB during the week of May 7-11, 1984. The purpose of this sampling was to determine the areal extent of surface contamination at

FIGURE I.26

EDWARDS AFB

ELECTRICAL RESISTIVITY PROFILE MAP SITE 2

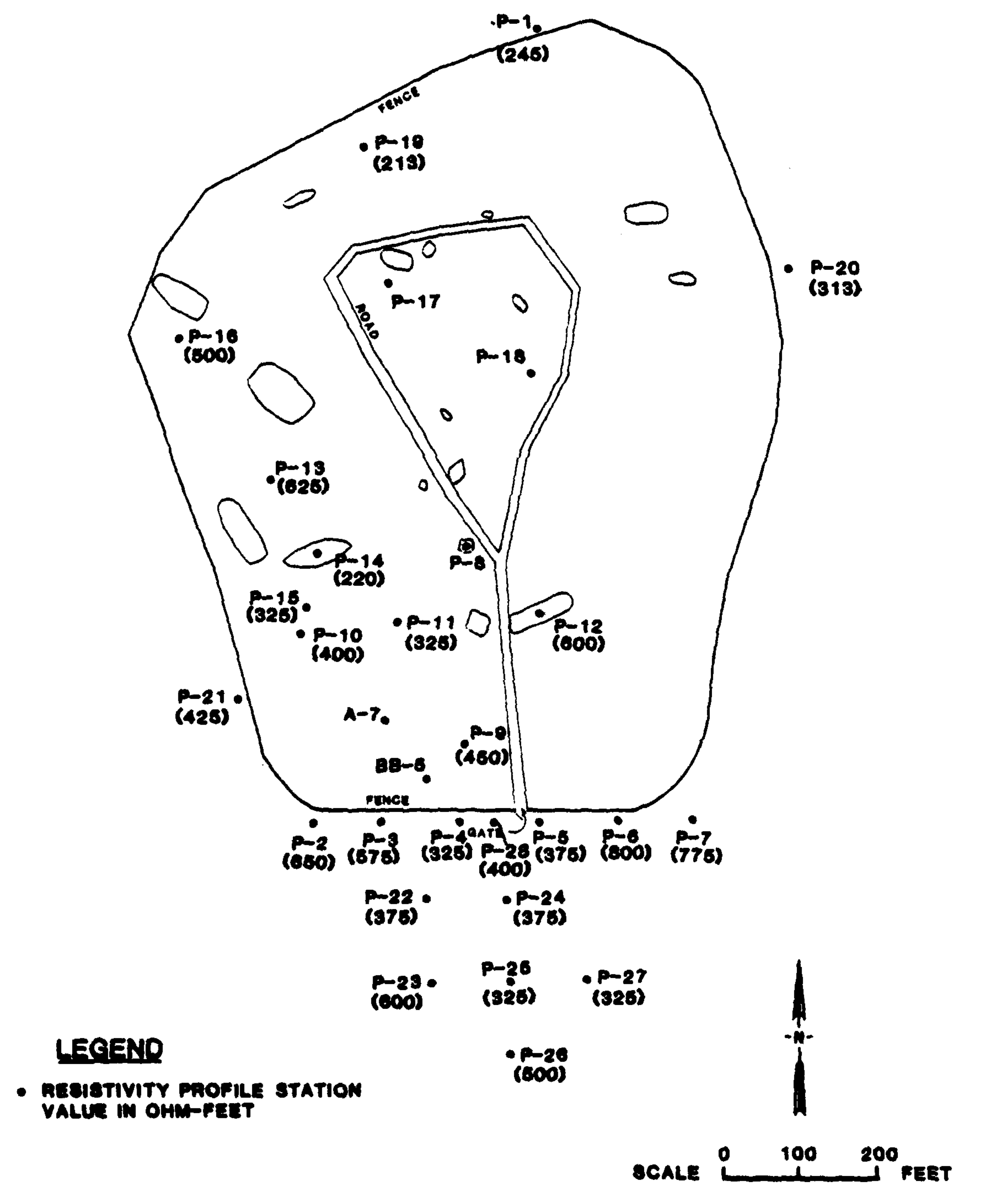
(Electrode Spacing of 20 feet)



EDWARDS AFB

ELECTRICAL RESISTIVITY PROFILE MAP SITE 2

(Electrode Spacing of 50 feet)



ENGINEERING-SCIENCE

Subsites 1A, 1B, 1C, 1D, and 1E and to determine the magnitude of contamination in each of the areas of geophysical anomaly at Site 2. The sampling procedures, sample locations, and analytical parameters were selected based on information provided in the Phase II IRP report and on results of the electrical resistivity survey, magnetometer surveys, and site inspection conducted by ES at Sites 1 and 2 during the periods April 23 - May 3, 1984. The discussion which follows presents the sampling locations and a summary of results.

Sampling Locations and Analytical Parameters

Phase IV sampling at Site 1 (North Lake Bed Disposal and Storage Site) consisted of collecting a series of surface soil samples at Subsites 1A, 1B, 1C, 1D, and 1E and collecting samples of the contents of selected accessible drums at Subsites 1B and 1E.

The surface soil samples were collected to confirm the surficial area of contamination and pit areas as presented in the earlier Phase I and Phase II work. This information was necessary to ascertain the required cap coverage, potential soil excavation areas (if necessary), and the location of monitoring wells. Selected drum samples were analyzed to determine the compatibility of the materials and the nature of the waste. This information will be needed for off-site contract disposal purposes.

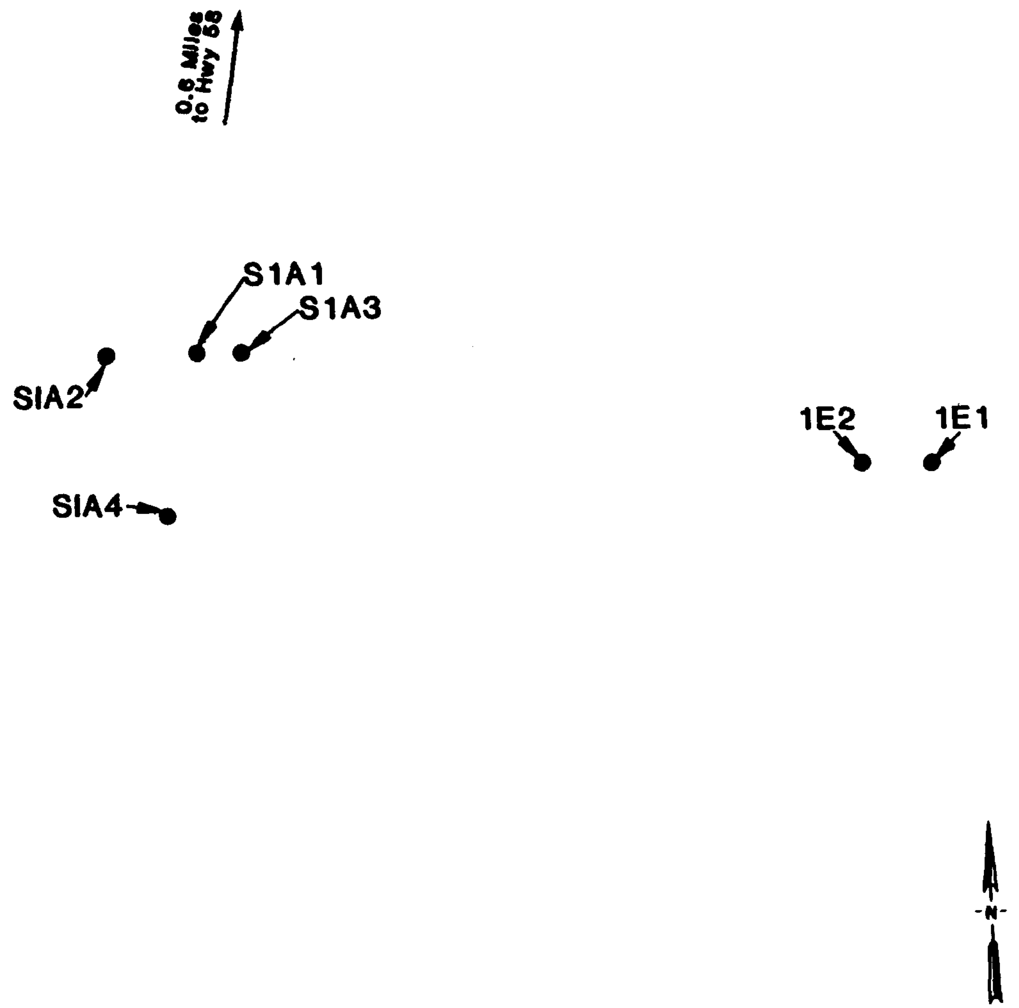
Phase IV sampling at Site 2 (Main Base Waste Disposal Site) consisted of collecting soil boring samples from suspected waste pits as located by the geophysical survey, posted site signs and a visual inspection of the site. This information was necessary to ascertain the location of the waste pits and the magnitude of contamination so that the appropriate remedial action could be selected.

Subsite 1A

Four samples were collected at Subsite 1A as shown in Figure I.28. One common background sample was collected for both sites 1A and 1E. The samples were analyzed for halogenated volatiles in accordance with Method 8010 as defined in SW-846.

EDWARDS AFB

SURFACE SOIL SAMPLING LOCATIONS SITES 1A & 1E



LEGEND

●S1A1 Sample No. and Location

ES ENGINEERING-SCIENCE

Subsite 1B

Seven soil samples including one background, were collected at Subsite 1B. In addition, five of the open drums located at Subsite 1B were sampled. All the samples were analyzed for volatiles in accordance with Method 8010 as defined in SW-846.

Subsite 1C

Fifteen surface soil samples were collected within and adjacent to the four nitric acid pits at Site 1 (Figure I.29). The sample locations were selected to confirm the extent of area nitrate contamination. Each sample was analyzed for nitrate and pH. Nitrate was analyzed in accordance with EPA Method 353.1 on a water leach. pH was determined using EPA Method 150.1 on a 1:1 water slurry.

Subsite 1D

Eleven surface samples were collected at Subsite 1D1 and 1D2 as illustrated in Figure I.30. These sample locations were selected to determine if drum spillage or leakage had occurred in or adjacent to the drum trenches. These samples were analyzed for halogenated volatiles in accordance with Method 8010.

Subsite 1E

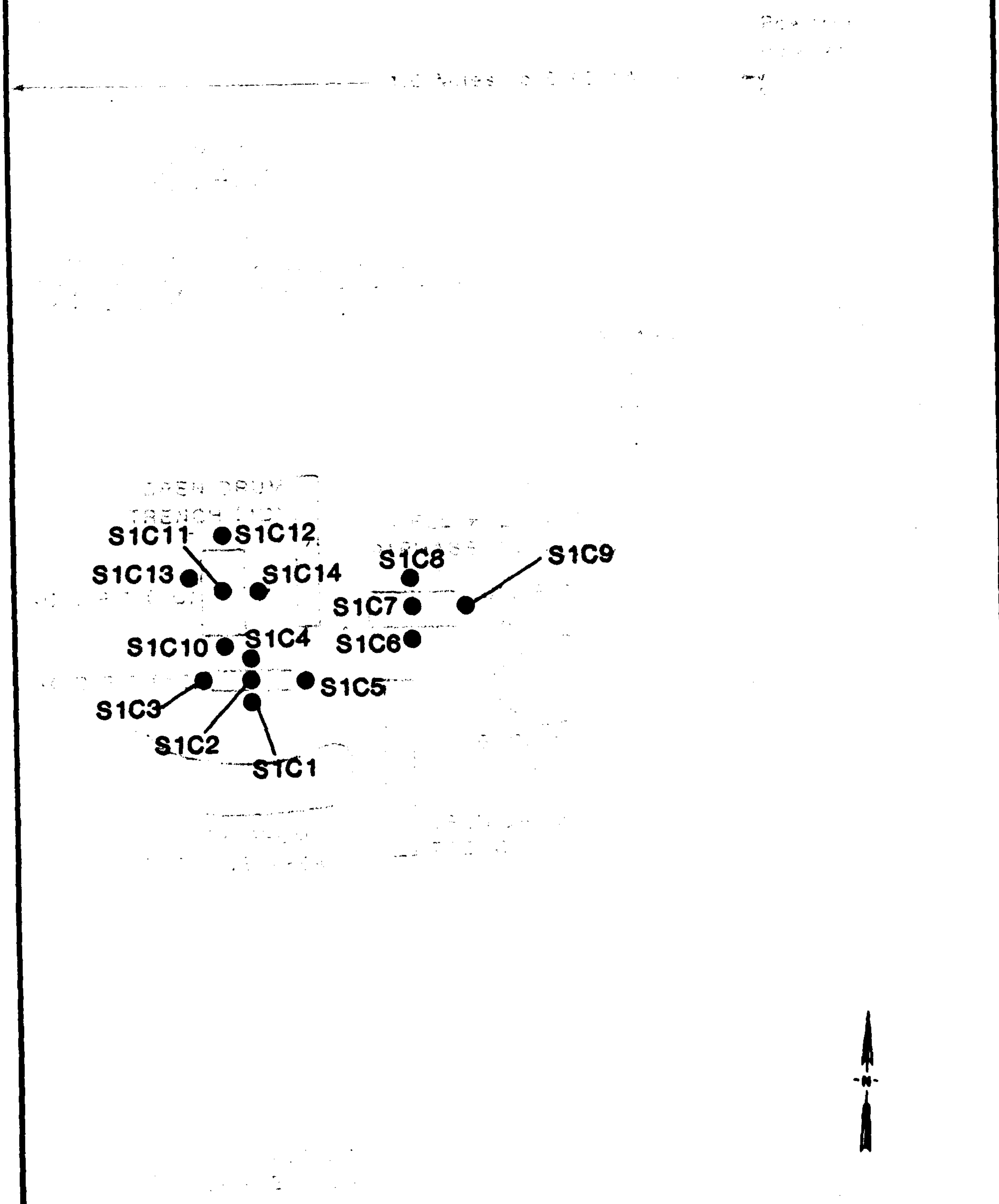
Two surface soil samples were collected at Subsite 1E as shown in Figure I.28. These samples were analyzed for halogenated volatiles. One open drum containing a white granular solid was also sampled at Subsite 1E. This sample was analyzed using EPA Method 200.7 on a nitric acid and peroxide digestion of the solid.

Site 2

A series of soil borings were performed at twenty-two locations, both within and outside the fenced area at Site 2 (Figure I.31). These borings were located at each of the 17 areas identified as potential waste pits during the geophysical survey. In addition several other soil borings within the fence and north and south of the fence were performed. Three samples were collected at each soil boring location using a driven split spoon sampler. A sample was collected at 0-1' depth, mid-depth, and at bedrock (18-20'). The mid-depth location was

FIGURE I.29

EDWARDS AFB
SURFACE SOIL SAMPLING LOCATIONS SITE 1C



ES ENGINEERING-SCIENCE

FIGURE I.30

EDWARDS AFB

SURFACE SOIL SAMPLING LOCATIONS SITE 1D

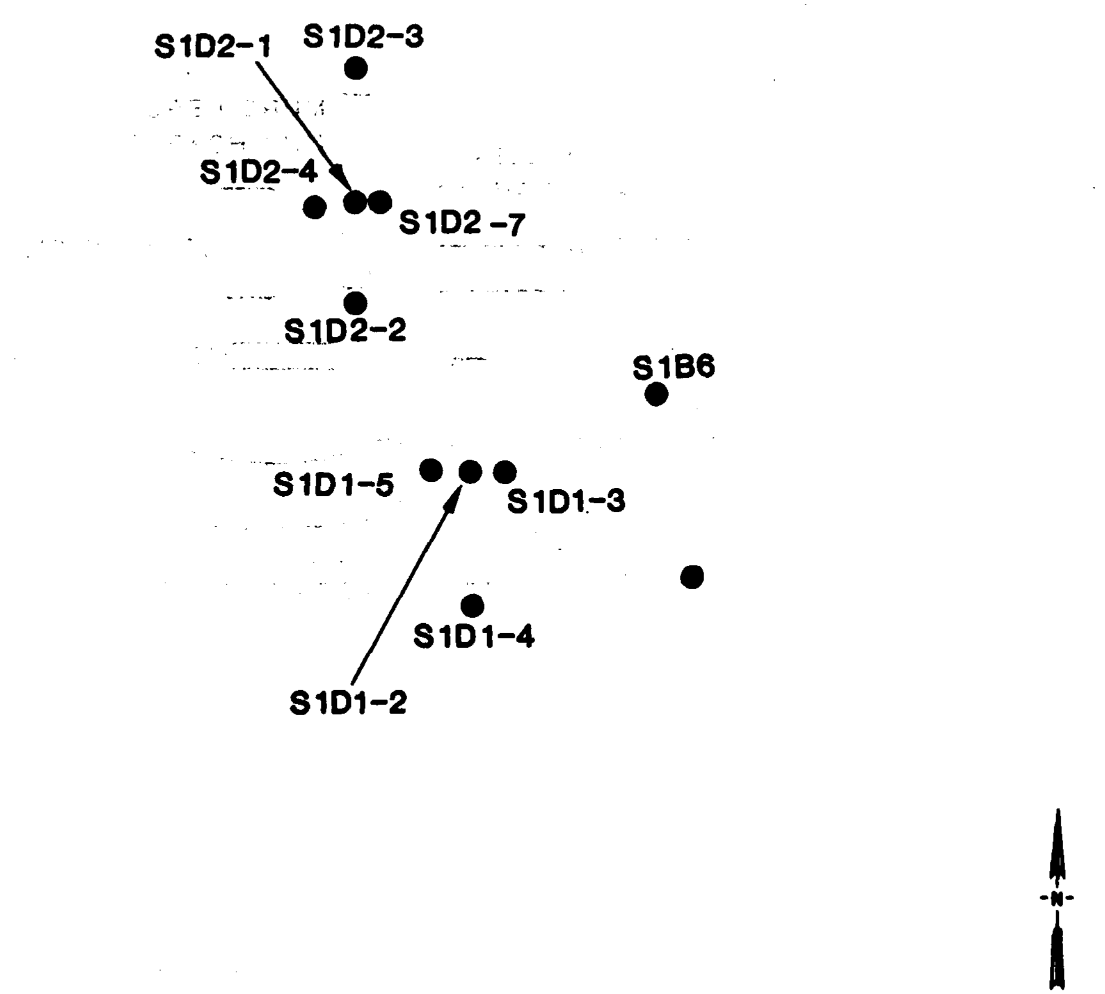
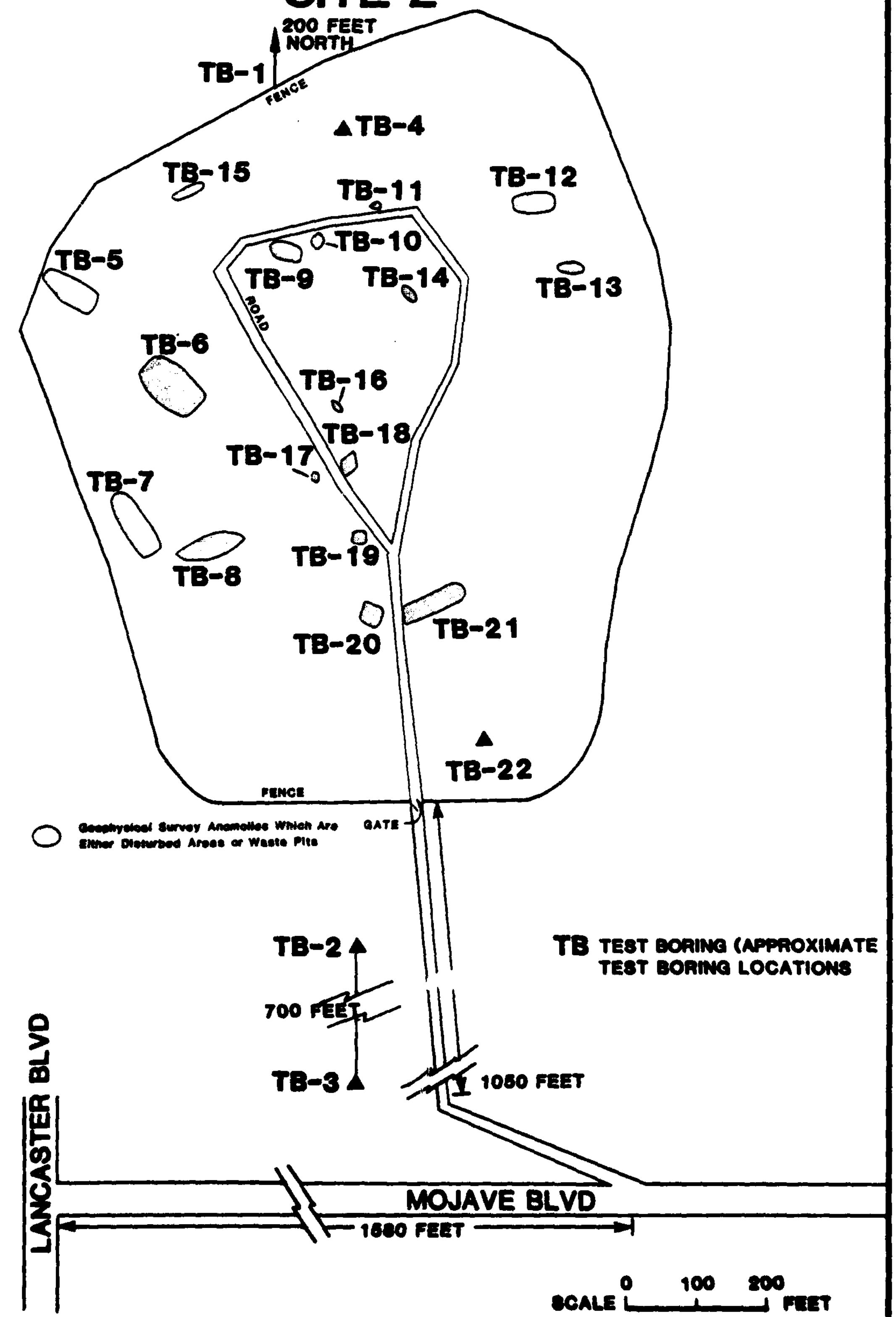


FIGURE I.31

EDWARDS AFB

RELATIVE LOCATION OF PITS BASED ON MAGNETOMETER SURVEY SITE 2



selected for each location at the depth of geophysical anomaly. Selected soil samples (any visually contaminated samples and samples in areas of peak geophysical anomaly) were analyzed for pH, cyanide, nitrate, total chromium, hexavalent chromium and total lead.

Results of Sampling and Analysis

Tables I.1 and I.2 summarize the analytical results of the soil sampling conducted at Sites 1 and 2 respectively.

Forty-five drums located at Subsites 1B and 1D were sampled. The samples (or each phase if two phases were present) were screened for water miscibility/reactivity, pH, cyanide, sulfide and flashpoint. Based on the results of compatibiliy tests conducted, all the drummed wastes except one small container are compatible (Table I.3a and I.3b). All sulfide and cyanide concentrations were <0.5 ppm and <0.1 ppm respectively. All flashpoints were >140°F. pHs ranged from 4.1 to 8.6. In general, the drums have one to two liquid phases. A composite of the lower aqueous phase was extracted with dichloromethane and the extract was analyzed by GC/MS for EPA Method 625 pollutants. No acid or base/ neutral priority pollutants were present at or above detection limits of 5 ppm or 1 ppm respectively with the exception of isophorone which was present at 2 ppm. A complex mixture of esters and ketones was present at about 550 ppm (total). In addition, the lower aqueous phases were composited and analyzed by GC-FID for C_1 to C_6 alcohols. None were present at or above the detection limit (2 percent). The upper phases (oil) were composited and analyzed by GC-ED for Arochlors 1242, 1248, 1254 and 1260. No PCBs were present at or above the detection limit (5 ppm).

The analytical results for the sample of white granular solid obtained from the only open drum at Subsite 1E are presented in Table I.4.

TABLE I.1

SITE 1
SOIL SAMPLE LOCATIONS AND RESULTS OF CHEMICAL ANALYSIS

Site	Sample Location	Depth (Feet)	Halogenated Volatiles (mg/Kg)	pH Units	NO_3^-N (mg/Kg)
1A	S1A1	0.33	ND	NA	NA
	S1A2	0.33	NA	NA	NA
	S1A3	0.33	NA	NA	NA
	S1A4(Background)	0.33	ND	NA	NA
1B	S1B1	0.33-0.5	ND	NA	NA
	S1B2	0.33-0.5	ND	NA	NA
	S1B3	0.33-0.5	NA	NA	NA
	S1B4	0.33-0.5	NA	NA	NA
	S1B5	0.33-0.5	NA	NA	NA
	S1B6	0.33-0.5	NA	NA	NA
	S1B7(Background)	0.33-0.5	NA	NA	NA
1C	S1C1	0-0.5	NA	NA	NA
	S1C1-D	0-0.5	NA	7.7	5.3
	S1C2	0-0.5	NA	7.3	8.3
	S1C3	0-0.5	NA	8	4.5
	S1C4	0-0.5	NA	7.6	491
	S1C5	0-0.5	NA	8	7.6
	S1C6	0-0.5	NA	7.9	21
	S1C7	0-0.5	NA	5.8	3640
	S1C8	0-0.5	NA	7.7	8.8
	S1C9	0-0.5	NA	8.3	1.16
	S1C10	0-0.5	NA	NA	NA
	S1C11	0-0.5	NA	7.5	10,000
	S1C12	0-0.5	NA	7.6	30
	S1C13	0-0.5	NA	7.8	18
	S1C14	0-0.5	NA	7.4	34
1D1	S1D1-1	0.33	ND	NA	NA
	S1D1-2	0.33	ND	NA	NA
	S1D1-3	0.33	ND	NA	NA
	S1D1-4	0.33	ND	NA	NA
	S1D1-5	0.33	ND	NA	NA
	S1D1-5D	0.33	ND	NA	NA
	S1D1-6	0.33	ND	NA	NA
	S1D1-7	0.33	ND	NA	NA

TABLE I.1 (continued)

Site	Sample Location	Depth (Feet)	Halogenated Volatiles (mg/Kg)	pH Units	NO_3-N (mg/Kg)
1D2	S1D2-7	0.33	ND	NA	NA
	S1D2-1	0.33	ND	NA	NA
	S1D2-1D	0.33	ND	NA	NA
	S1D2-2	0.33	ND	NA	NA
	S1D2-3	0.33	ND	NA	NA
	S1D2-4	0.33	ND	NA	NA
1E	S1E1	0.5	ND	NA	NA
	S1E2	0.5	ND	NA	NA

NOTES:

ND: Not detected

NA: Not analyzed either because analytical parameter was inappropriate for the location or because the sample was collected due to sampling convenience and was to be analyzed only if results of other samples indicated a need for additional analysis to quantify the extent of soil contamination.

TABLE I.2

SITE 2
SOIL SAMPLE LOCATIONS AND RESULTS OF CHEMICAL ANALYSIS

Test Boring Numbers	Depth of Sample	CN- mg/Kg	Cr mg/Kg	Cr+6 mg/Kg	NO_3- mg/Kg	Pb mg/Kg	pH Units
TB-1	5-6'	<0.1	76	<0.1	8.0	3.3	9.1
TB-2	5-6'	<0.1	33	<0.1	9.4	6.2	8.2
TB-3	5-6'	<0.1	47	<0.1	<1	1.7	8.0
TB-1	1-2'	<0.1	9.7	NA	8.2	3.0	7.8
TB-1	15-16'	<0.1	6.5	NA	3.4	1.6	9.0
TB-2	0-1'	<0.1	25	<0.1	2.1	3.7	8.3
TB-2	19-20'	<0.1	46	<0.1	4.0	2.4	8.0
TB-3	0-1'	<0.1	25	NA	2.2	9.2	7.8
TB-3	18.4'	<0.1	35	NA	2.4	1.6	8.7
TB-4	0-1'	<0.1	46	NA	9.2	3.5	8.3
TB-4	5-6'	<0.1	7.5	NA	<1	1.2	7.3
TB-5	1'	<0.1	30	<0.1	5.2	3.6	7.6
TB-6	1'	<0.1	13	NA	6.3	4.3	7.3
TB-7	1'	<0.1	24	NA	8.2	3.8	7.1
TB-8	1.5'	<0.1	12	NA	<1	5.8	7.5
TB-9	5-6'	<0.1	13	NA	12	5.1	8.3
TB-10	0-1'	<0.1	25	<0.1	4.7	41	8.1
TB-11	5-6'	<.1	13	NA	2.7	8.8	7.2
TB-12	4'	<0.1	14	NA	16	21	8.3
TB-13	2'	<0.1	14	NA	<1	4.9	9.0
TB-14	5-6'	<0.1	4.1	NA	<1	2.3	8.8
TB-15	5-6'	<0.1	6.3	NA	<1	5.0	8.2
TB-16	5-6'	<0.1	16	NA	20	3.3	8.8
TB-17	5-6'	<0.1	8.2	NA	93	4.2	8.1
TB-18	5-6'	<0.1	12	NA	<1	2.0	8.4
TB-19	5-6'	<0.1	11	NA	<1	2.8	8.7
TB-20	5-6'	<0.1	14	NA	<1	3.1	8.0
TB-21	0-1'	<0.1	6.0	NA	<1	2.9	8.3
TB-22	3'	<0.1	12	NA	<1	5.8	8.2
TB-22	0-1'	<0.1	11	<0.1	<1	4.8	8.2

NA: Not Analyzed - Cr^{+6} was analyzed only for selected samples containing the maximum total chromium values found on Site 2.

TABLE I.3A

SUBSITES 1B/1D
DRUM WASTE COMPATIBILITY RESULTS
EDWARDS AFB, CALIFORNIA

			VISUAL						WATER MISCIBILITY/REACTIVITY					
Sample ID No.	Date of Sample	No. of Liquid Phases	Approximate Proportions (%) U	L	Color U	L	Solids Present?	Odor	Water Reactive? U	L	Precipitate or Emulsion? U	L	Water Miscible U	L
18604-1 C1D-101	6/19	2	25	75	Brown	Clear	Yes	Petroelum Oil	No	No	No	No	No	Yes
18604-2 C1D-102	6/19	1	NA	NA	Yellow/ Orange	NA	Yes	Phenolic	no	NA	No	NA	No	NA
18604-3 D1B-1	6/19	2	5	95	Black	Yellow/	Yes	Tar	No	No	No	No	No	Yes
18604-4 D1B-2	6/19	2	15	85	Lt.Brown	Clear	Yes	Petroleum Oil	No	No	No	No	No	Yes
18604-5 D1B-3	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-6 D1B-4	6/19	2	20	80	Brown	Clear	Yes	Petroleum Oil	No	No	Slight Emulsion	No	No	Yes
18604-7 D1B-5	6/19	1	NA	NA	Lt.Brown	NA	Yes	Vegetable Oil	No	NA	No	NA	Yes	NA
18604-8 D1B-6	6/19	2	5	95	Lt.Brown	Clear	Yes	Vegetable Oil	No	No	No	No	No	Yes
18604-9 D1B-9	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-10 D1B-10	6/19	1	NA	NA	Yellow	NA	No (rust)	Paint Thinner	No	NA	Slight Emulsion	NA	No	NA
18604-11 D1B-11	6/19	2	80	20	Yellow/ Grey	Clear	Yes (paint chips, rust)	Petroleum Oil	No	No	Slight Emulsion	No	No	Yes
18604-12 D1B-12	6/19	1	NA	NA	Yellow	NA	Yes (paint chips, rust)	Unknown	No	NA	No	NA	No	NA
18604-13 D1B-13	6/19	2	50	50	Yellow	Clear	No (rust)	Oil	No	No	Slight Emulsion	No	No	Yes
18604-14 D1B-14	6/19	1	NA	NA	Red/ Brown	NA	No	Sweet, paint-like	No	NA	No	NA	Yes	NA
18604-15 D1B-16	6/19	2	70	30	Yellow	Clear	Yes (paint chips, rust)	Oil	No	No	Slight Emulsion	No	No	Yes
18604-16 D1B-29	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-17 D1B-36	6/19	1	BA	BA	Clear	NA	No (rust)	Sour (vinegar-like)	No	NA	No	NA	Yes	NA
18604-18 D1B-41	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-19 D1B-42	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-20 D1B-43	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-21 D1B-44	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-22 D1B-45	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-23 D1B-48	6/19	1	NA	NA	Black/ Brown	NA	No (rust)	Unknown	No	NA	No	NA	Yes	NA
18604-24 D1B-50	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-25 D1B-52	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-26 D1B-56	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-27 D1B-60	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-28 D1B-68	6/19	2	5	95	Brown	Yellow/ Clear	No (rust)	Paint	No	No	No	No	No	Yes
18604-29 D1B-75	6/19	2	3	97	Whitish Brown	Clear	Yes	Paint	No	No	Slight Emulsion	No	No	Yes

TABLE I.3 (continued)

Sample ID No.	Date of Sample	No. of Liquid Phases	VISUAL Approximate Proportions (%) U	L	Color U	Color L	Solids Present?	Odor	WATER MISCIBILITY/REACTIVITY Water Reactive? U	L	Precipitate or Emulsion? U	L	Water Miscible U	L
18604-30 D1B-76	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-31 D1B-78	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-32 D1B-79	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-33 D1B-81	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-34 D1B-82	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-35 D1B-86	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-36 D1B-87	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-37 D1B-88	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-38 D1B-91	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-39 D1B-93	6/19	2	10	90	Brown	Yellow/ Clear	Yes	Petroleum Oil	No	No	Slight Emulsion	No	No	Yes
18604-40 D1B-96	6/19	1	NA	NA	Black	NA	Yes	Tar	No	NA	No	NA	Yes	NA
18604-41 D1B-97	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-42 D1D-103	6/19	2	15	85	Brown	Clear	Yes	Oil	No	No	No	No	No	Yes
18604-43 D1D-104	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-44 D1D-105	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA
18604-45 D1D-106	6/19	1	NA	NA	Clear	NA	No (rust)	None	No	NA	No	NA	Yes	NA

NOTES:
NA: Not Applicable
U: Upper layer
L: Lower layer

TABLE I.3B

SUBSITES 1B/1D
DRUM WASTE COMPATIBILITY RESULTS
EDWARDS AFB, CALIFORNIA

			If Water Miscible?						If Water Immiscible?					
					If pH >6?								Flash Point	
		Date of	pH		Sulfide		Cyanide		Density		If Density >1*		°F	
Sample ID No.		Sample	U	L	U	L	U	L	U	L	U	L	U	L
18604-1	C1D-101	6/19	NA	8.1	NA	<0.5	NA	<0.1	<1	NA	NA	NA	>140	NA
18604-2	C1D-102	6/19	NA	NA	NA	NA	NA	NA	>1	NA	No Halo-gens	NA	>140	>140
18604-3	D1B-1	6/19	NA	5.5	NA	NA	NA	NA	<1	NA	NA	NA	>140	>140
18604-4	D1B-2	6/19	NA	5.9	NA	NA	NA	NA	<1	NA	NA	NA	>140	NA
18604-5	D1B-3	6/19	6.3	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	>140
18604-6	D1B-4	6/19	NA	4.9	NA	NA	NA	NA	<1	NA	NA	NA	>140	NA
18604-7	D1B-5	6/19	4.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	>140	NA
18604-8	D1B-6	6/19	NA	7.0	NA	<0.5	NA	<0.1	<1	NA	NA	NA	>140	>140
18604-9	D1B-9	6/19	6.9	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	NA
18604-10	D1B-10	6/19	NA	NA	NA	NA	NA	NA	<1	NA	NA	NA	>140	NA
18604-11	D1B-11	6/19	NA	4.6	NA	NA	NA	NA	<1	NA	NA	NA	>140	>140
18604-12	D1B-12	6/19	NA	NA	NA	NA	NA	NA	<1	NA	NA	NA	>140	NA
18604-13	D1B-13	6/19	NA	5.1	NA	NA	NA	NA	<1	NA	NA	NA	>140	>140
18604-14	D1B-14	6/19	4.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	>140	NA
18604-15	D1B-16	6/19	NA	3.6	NA	NA	NA	NA	<1	NA	NA	NA	>140	>140
18604-16	D1B-29	6/19	6.3	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	NA
18604-17	D1B-36	6/19	4.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	>140	NA
18604-18	D1B-41	6/19	7.9	NA	<0.5	NA	0.1	NA	NA	NA	NA	NA	>140	NA
18604-19	D1B-42	6/19	7.3	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	NA
18604-20	D1B-43	6/19	7.5	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	NA
18604-21	D1B-44	6/19	7.9	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	NA
18604-22	D1B-45	6/19	7.6	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	NA
18604-23	D1B-48	6/19	9.6	NA	<5**	NA	<1	NA	NA	NA	NA	NA	>140	NA
18604-24	D1B-50	6/19	7.2	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	NA
18604-25	D1B-52	6/19	7.1	NA	<0.5	NA	0.1	NA	NA	NA	NA	NA	>140	NA
18604-26	D1B-56	6/19	6.8	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	NA
18604-27	D1B-60	6/19	6.7	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	NA
18604-28	D1B-68	6/19	NA	4.3	NA	NA	NA	NA	<1	NA	NA	NA	>140	>140
18604-29	D1B-75	6/19	NA	4.1	BA	BA	BA	BA	<1	NA	NA	NA	>140	>140
18604-30	D1B-76	6/19	6.9	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	NA
18604-31	D1B-78	6/19	6.7	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	NA
18604-32	D1B-79	6/19	6.8	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	NA
18604-33	D1B-81	6/19	6.8	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	NA
18604-34	D1B-82	6/19	7.3	NA	<0.5	NA	0.1	NA	NA	NA	NA	NA	>140	NA
18604-35	D1B-86	6/19	7.6	NA	<0.5	NA	0.1	NA	NA	NA	NA	NA	>140	NA
18604-36	D1B-87	6/19	7.1	NA	<0.5	NA	<0.5	NA	NA	NA	NA	NA	>140	NA
18604-37	D1B-88	6/19	6.7	NA	<0.5	NA	0.1	NA	NA	NA	NA	NA	>140	NA
18604-38	D1B-91	6/19	6.6	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	NA

TABLE I.3B (continued)

		If Water Miscible?						If Water Immiscible?					
				If pH ≥6?								Flash Point °F	
	Date of	pH		Sulfide		Cyanide		Density		If Density >1*			
Sample ID No.	Sample	U	L	U	L	U	L	U	L	U	L	U	L
18604-39 D1B-93	6/19	No	6.3	No	<0.5	No	<0.1	<1	NA	No	NA	>140	>140
18604-40 D1B-96	6/19	8.1	NA	<5**	NA	<1	NA	NA	NA	NA	NA	>140	NA
18604-41 D1B-97	6/19	6.2	NA	<0.5	NA	<0.1	NA	NA	NA	NA	NA	>140	NA
18604-42 D1D-103	6/19	NA	6.6	NA	<0.5	NA	<0.1	<1	NA	NA	NA	>140	>140
18604-43 D1D-104	6/19	4.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	>140	NA
18604-44 D1D-105	6/19	5.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	>140	NA
18604-45 D1D-106	6/19	5.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	>140	NA

NOTES:
NA: Not Applicable
U: Upper layer
L: Lower layer
* Beilstein Test
** Because of sample color, sample had to be distilled to run.
1) All concentrations are in mg/l, except pH (units), density (gm/cc), and flash point (°F).

TABLE I.4

RESULTS OF SITE 1E DRUM WASTE ANALYSIS

Analyte	Result (mg/g)	Analyte	Result (mg/g)	Analyte	Result (mg/g)
Silver	<.11	Mercury	<3	Selenium	<4.3
Aluminum	370	Indium	<5	Silicon	390
Arsenic	<18	Potassium	2,400	Tin	<12
Gold	<3	Lithium	24	Strontium	32
Boron	18,000	Magnesium	440	Tellurium	<10
Barium	8.5	Manganese	35	Titanium	14
Beryllium	<.025	Molybdenum	0.88	Thallium	<4.7
Bismuth	<5	Sodium	34%	Uranium	<6
Calcium	780	Nickel	1.4	Vanadium	1.2
Cadmium	<.11	Phosphorous	<18	Tungsten	<3
Cobalt	0.54	Lead	<4.3	Yttrium	<.2
Chromium	5.2	Platinum	<3	Zinc	11
Copper	3.5	Sulfur	3,300		
Iron	1,300	Antimony	<3		

NOTE: (1) Only one 55-gallon drum was located at Site 1E. This drum contains a white granular solid.

Summary of Soil and Drummed Waste Analytical Results

The results of the additional soil and drummed waste sampling and analysis at Sites 1 and 2 form the basis for the following summary.

- All drummed wastes sampled at Subsites 1B and 1D are compatible except for one small container.
- Halogenated volatile organics were not detected in the surface soils within and adjacent to Sites 1A, 1B, 1D1, 1D2, and 1E.
- The only significant nitrate contamination (>45 mg/l NO_3-N) in the surface soils at Subsite 1C is within the pit boundaries as defined in Figure I.29.
- Cyanide concentrations were below 0.1 mg/Kg at all pit locations. All lead concentrations were less than 10 mg/Kg except at TB-10 and TB-12 which were 41 mg/Kg and 21 mg/Kg respectively. These concentrations are below the 50 mg/Kg total threshold limit criteria proposed in the California Assessment Manual for Hazardous Wastes. Total chromium was less than 76 mg/Kg at all locations which is also below the 300 mg/Kg total threshold limit. No hexavalent chromium was present in any of the samples tested.

APPENDIX J

REFERENCES

APPENDIX J

REFERENCES

1) American Conference of Government Industrial Hygienists, Inc. Documentation of Threshold Limit Values, 7th Edition. 1983.

2) Bison. Instruction Manual, Bison Instruments, Earth Resistivity Meters: Bison Instruments, Inc. Minneapolis, Minnesota. 1975.

3) Breiner, S. Applications Manual For Portable Magnetometers: Geometrics. Sunnyvale, California. 1973.

4) California Department of Health Services. California Assessment Manual for Hazardous Wastes. August, 1979.

5) California Department of Water Resources. Planned Utilization of Water Resources in Antelope Valley. 1980.

6) Carrington, T. J. and D. A. Watson. Preliminary Evaluation of an Alternate Electrode Array for Use in Shallow-Subsurface Electrical Resistivity Studies: Ground Water - January-February, 1981. Vol. 10, No. 1. 1981.

7) Directorate of Environmental Planning HQ/AFESC. Installation Restoration Program Phase IV Management Guidance. January 31, 1984.

8) Engineering-Science, Inc. Draft Report on Supplemental Phase II Work at Edwards AFB. December 29, 1983.

9) Engineering-Science, Inc. Final Report Installation Restoration Program Phase II Confirmation, Edwards AFB, California. September, 1982.

10) Envirodyne Engineers, Inc. Assessment of the Landfill for Groundwater Contamination - Edwards Air Force Base Disposal Site Evaluations. April 30, 1981.

11) Hazzard, Grace. Personal Communication. National Highway Traffic Safety Administration. Washington, D. C. August 11, 1983.

12) Journal Water Pollution Control Federation Conference. Vol. 54. No. 6. June, 1982. P.883ff.

13) Sax, N. Irving. Dangerous Properties of Industrial Materials. 5th Edition. Von Nostrand Reinhold. 1979.

14) Tappio, Captain. Personal Communication. AFESC/RDV Tyndall AFB, Florida (April 26, 1984).

APPENDIX K

MAILING LIST FOR FINAL REMEDIAL ACTION PLAN

APPENDIX K

MAILING LIST FOR SUBMITTAL OF FINAL REMEDIAL ACTION PLAN

Address	No. of Copies
HQ AFSC/DEMV Mr. George Schlossnagle Building 1535, Room DE310 Andrews AFB, Maryland 20334 Telephone 301/981-6341	13
SAF/LLP ATTN: LLP (Call 77950 for Package Pickup) Room 5D 872 Pentagon Washington, DC 20330 Telephone AV 227-7950 Comm. 703/697-7950	5
SAF/MIQ ATTN: MIQ (Call 79297 for Package Pickup) LTC Philip Brown Room 4C 916 Pentagon Washington, DC 20330 Telephone AV 227-9297 Comm. 703/697-9297	1
U.S. Army Corps of Engineers Omaha District ATTN: MROED-S (Paul Dappen) 215 North 17th Street Omaha, Nebraska 68102 Telephone 402/221-3175/3176	10
HQ AFESC/DEV Building 1120 Tyndall AFB, Florida 32403 Telephone 904/283-6193	1

NOTE: Circled - Release by Schlossnagle (AFSC)
Uncircled - Release by Christopher (ES)

Address	No. of Copies
HQ AFESC/RDV Building 710 Tyndall AFB, Florida 32403 Telephone 904/283-2097	1
HQ AFESC/PA Building 1120 Tyndall AFB, Florida 32403 Telephone 904/283-6576	1
HQ USAF/LEEVP Building NO. 516 Bolling AFB Washington, DC 20332 Telephone DC 767-6241	1
HQ USAF/SGES Building No. 5681 Bolling AFB Washington, DC 20332 Telephone DC 767-5078	1
HQ AFFTC/DEEV Mr. Terry Yonkers Building 3500 Edwards AFB, California 93523 Telephone 805/277-4730	10
HQ AFRCE/WR Mr. Robert B. Cameron 630 Sansome Street., Room 1316 San FRancisco, California 94111 Telephone 415/556-6439	10
HQ U.S. Army Corps of Engineers ATTN: DAEN-ECE-B (Mr. Jim Ballif) Pulaski Building, Room 6131 20 Massachusetts Ave., NW Washington, DC 20314 Telephone 202/272-0216	6

Address	No. of Copies
HQ AFSC/JAM Major John Harte Building 1535, Room B104 Andrews AFB, Maryland 20334 Telephone 301/981-7475	1
HQ AFSC/SGPB COL Paul Fallon Building 1535, Room B204 Andrews AFB, Maryland 20334 Telephone 301/981-5235	1
HQ AFSC/PA COL Alan Shoemaker Building 1535, Room EE319 Andrews AFB, Maryland 20334 Telephone 301/981-3241	1
AFMSC/SGP Building No. 150 Brooks AFB, Texas 78235 Telephone 512/536-2452	1
USAF OEHL/TS Building No. 140, First Trailer Brooks AFB, Texas 78235 Telephone 512/536-2158	1
Defense Technical Information Center For NTIS System Cameron Station Alexandria, Virginia 22314	1
U.S. Army Corps of Engineers Edwards AFB Resident Office ATTN: Mr. Gary W. Gaynor Building No. 3750 Edwards AFB, California 93523	1

Address	No. of Copies
U.S. Army Corps of Engineers South Pacific Division ATTN: SPDCO-C-EP (Mr. Tony Mei) 630 Sansome (Room 1216) San Francisco, California 94111 Telephone 415/556-5015	1
U.S. Army Crops of Engineers South Pacific Division ATTN: SPCDO (Marsha Gilbert) 630 Sansome (Room 1216) San Francisco, California 94111 Telephone 415/556-1701	1
U.S. Army Corps of Engineers Los Angeles District ATTN: Mr. Chris Kronick, Safety Office 645 North Durfee Avenue South El Monte, California 91733 Telephone 213/283-2757	1
USAF Hospital/SGPB Edwards AFB, California 93523 ATTN: Major Gary Fishburn Telephone: 805/277-3272	2

APPENDIX L

FEDERAL, STATE AND LOCAL AGENCY COMMENTS RECEIVED ON FINAL REMEDIAL ACTION PLAN

APPENDIX L

FEDERAL, STATE, AND LOCAL AGENCY COMMENTS RECEIVED ON THE FINAL REMEDIAL ACTION PLAN

During the development of this Phase IV Remedial Action Plan, numerous meetings (formal and informal) have been held to keep the local, state and Federal regulatory agencies abreast of the Phase IV activities as well as to obtain their comments and suggestions regarding the selected remedial actions.

The following meetings have been conducted during the course of this project:

Meeting	Attendees	Location	Date
Phase IV Project Kickoff	USAF, COE, ES	Edwards AFB, CA	April 11, 1984
Phase IV Project Review	USAF, COE, ES	Edwards AFB, CA	April 25, 1984
Phase IV Overview Review	USAF, ES, CALDHS	Fresno, CA	April 27, 1984
Phase IV Overview Review	USAF, ES, Kern County Dept. of Health Services, Kern County APCD	Bakersfield, CA	May 1, 1984
Phase IV Overview Review	USAF, ES, Lanhontan RWQCB	Bakersfield, CA	May 3, 1984
Phase IV Overview Review	USAF, ES, EPA Region IX	San Francisco, CA	May 7, 1984
Preliminary Draft Remedial Action Plan Review	USAF, COE, ES (Telephone comments from EPA Region IX and Lahonton RWQCB)	Atlanta, GA	May 24, 1984

Meeting	Attendees	Location	Date
Draft Remedial Action Plan Review	USAF, COE, ES	Atlanta, GA	June 21, 1984
Site Visit and Draft Remedial Action Plan Review	USAF, ES, COE (All regulatory agencies invited)	Edwards AFB, CA	June 28, 1984
95% Design Review	USAF, COE, ES	Atlanta, GA	July 25, 1984

The written comments received on the Draft Remedial Action Plan are enclosed within this Appendix.

KERN COUNTY AIR POLLUTION CONTROL DISTRICT

1601 "H" Street, Suite 250
Bakersfield, California 93301-5199
Telephone: (805) 861-3682

LEON M HEBERTSON, M.D.
Director of Public Health
Air Pollution Control Officer

May 18, 1984

Mr. Terry A. Yonkers
AFFTC/DEEV/Stop 210
AFFTC Environmental Coordinator
Building 3500, Civil Engineering
Edwards AFB, CA 93523

Dear Mr. Yonkers:

Subject: IV Installation Restoration Program

Thank you for the opportunity to review the above document. As stated at our informal meeting, the Kern County Air Pollution Control District is only concerned with the discharge of air contaminants which may result from implementation of this project. The proposed installation of equipment for incineration or venting of gases from underground strata may require the acquisition of an Authority to Construct pursuant to Rule 201(a). Should the above come to pass, we urge contact with our office far in advance of any equipment installations.

Again, thank you for the opportunity to review and comment on this proposed project. Should you or any other base personnel have questions regarding our position in this matter, please telephone our office at (805) 861-3682.

Sincerely,

LEON M HEBERTSON, M.D.
AIR POLLUTION CONTROL OFFICER

Clifton Calderwood

Clifton Calderwood
Assistant Chief Air Sanitation Officer

CC/cn

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
215 Fremont Street
San Francisco, Ca. 94105

24 MAY 1984

Terry A. Yonkers
Environmental Coordinator
AFFTC/DEEV/STOP 210
Edwards AFB, CA 93523

Dear Mr. Yonkers:

We have reviewed the Preliminary Draft of the Phase 4 - Remedial Action Plan and Conceptual Documents for Edwards Air Force Base, California and are providing a written copy of the comments we discussed during our phone conversation of May 24, 1984. Please be advised that our review and comments have been made with the same standards that EPA would apply to a site in the private sector. As such, anything less than "total removal" is considered an interim remedial measure, and the responsible party remains liable for any future problems.

Of the three sites covered in this report, we are most concerned with Subsite 1C because it presents the greatest potential danger to human health and the environment. Our comments regarding the remedial action alternatives for sites 1, 2, and 5 are as follows:

Site 1:

The proposed remedial action for Site 1 is Alternative 1-2. While this alternative should provide adequate protection from potential harm to human health and the environment for subsites 1A, 1B, 1D, and 1E, we feel that the proposed action will not provide adequate long term protection of human health and the environment at Subsite 1C.

Subsite 1C overlies the aquifer from which the town of North Edwards draws its water. The well is located 1,400 feet from the subsite. The subsite has not been used for over 20 years, yet nitrates have been detected at 965 ppm at 55 feet below the ground surface. A carefully constructed and monitored cap could prevent further migration of the nitrates. However, the possibility of contamination of the upper aquifer persists as long as the nitrates remain in the soil. Because contamination of a drinking water source is regarded as one of the most serious threats that a hazardous waste site can pose, long term solutions to such threats are considered in the best interest of the public. Indeed, long term solutions assure the responsible party that potential future legal actions or much more costly remedial actions will not be necessary.

While EPA recognizes that excavation of the nitrates would represent the preferred long term solution, we cannot recommend such an alternative until the costs for removing the appropriate amount of soil is determined. Therefore, we recommend that the Air Force further characterize the concentration of nitrates in the soil. The determination can then be made as to how deep it is necessary to excavate in order to remove the bulk of the nitrates and mitigate the threat of groundwater being contaminated to greater than 45 ppm nitrates. The Air Force should also consider the effectiveness of capping the site in conjunction with partial excavation of the nitrates. Further review of the costs and effectiveness of the various alternatives for Subsite 1C is recommended.

Remedial action at subsites 1A,1B, and 1E should involve excavation of contaminated top soils based on sampling results, rather than on visual inspection.

In order to meet the requirements of the National Contingency Plan, the community relations plan should be implemented at this point in time. Public input at this very critical phase of the decision process will ensure that public concerns have been properly addressed. This is especially important in regards to Subsite 1C, where impact on the public sector could potentially be the greatest.

Site 2:

Alternative 2-1 appears to be a satisfactory course of action for this site. However, EPA is still concerned with the possible presence of seasonal ground water beneath the site. If the on-going lysimeter survey detects seasonal groundwater, EPA will request reevaluation of the alternative chosen.

Site 2 and the surrounding areas have approximately a 2 to 3 percent slope toward the southeast; towards the main base areas and Rogers Lake (Phase 1 report, p.53). Phase 1 work also indicated that there is surface soil discoloration at this site. Therefore, run-off of surface contaminants during periods of heavy rainfall or flooding is a concern that needs to be addressed.

Potential fractures in the underlying bedrock could allow transport of contaminants through the bedrock into a previously uncontaminated zone during periods of heavy rainfall. Though there is no reported groundwater in the area, the long term effects of wide dispersion of the contaminant plume needs to be considered.

Because there will be no removal or destruction of various long lived contaminants, such as heavy metals and various organics, whose presence at Site 2 has been documented, EPA also recommends that all base real estate maps, and other pertinent maps, be updated to show the location of this hazardous waste disposal area.

Site 5:

EPA concurs with Alternative 5-4 for Site 5. However, excavation under the tanks should be based on a sampling program, rather than on visual observation.

Please be reminded that our review and comments apply only to sites 1, 2, and 5. We look forward to reviewing your Remedial Action Plan and Conceptual Documents for other sites as they become available, as well as reviewing the Work Plans for these sites as they become available. Please contact Marvin Young or Nick Morgan of my staff at (415) 974-8916 if you have any further questions.

Sincerely yours,

Harry Seraydarian
Director
Toxics and Waste Management Division

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
215 Fremont Street
San Francisco, Ca. 94105

June 14, 1984

Col. George R. Taylor, USAF
Director of Civil Engineering
Headquarters Air Force Flight Test Center (AFSC)
Edwards Air Force Base, CA 93523

Re: Edwards AFB, California (EPA ID No. CA1570024504)

Dear Col. Taylor:

This letter is in response to your letter of June 1, 1984 to Mr. Marvin Young, EPA requesting comments on the construction of a new Hazardous Waste Management (HWM) facility and on the closure of Facility 13762. Please note that on January 11, 1984 the EPA granted Interim Authorization to the State of California to operate Phase II, Component A of its hazardous waste program in lieu of the Federal program. This authorization includes the authority to issue RCRA permits for facilities that treat or store hazardous waste in tanks, containers, and piles. Thus, your proposed HWM facility and Facility 13762 fall under State jurisdiction. Please contact the appropriate regional office of the California Department of Health Services (DOHS) regarding any permit activities covered under this State authorization.

In response to your request, we are also providing the following comments. Please note that comments 1 and 2 are mutually exclusive; the specific regulatory authority used will be determined by DOHS.

1. Pursuant to 40 CFR 270.10(f), owners or operators must not begin physical construction of new HWM facilities until a final RCRA permit becomes effective, or until the requirements of 40 CFR 270.10(f)(3) have been satisfied. The approvals specified in this section and in other appropriate State regulations must be granted by DOHS.

2. Pursuant to 40 CFR 270.72 regarding changes during interim status, [redacted] implement the Federal and State regulations accordingly.

3. Pursuant to 40 CFR 265, Subpart G, Edwards AFB must comply with all Closure and Post-Closure requirements when closing Facility 13762. Again, DOHS has the regulatory authority to implement these and other appropriate State regulations, including the regulatory authority to grant approval for closure.

If you have any questions, please contact our Industry Assistance Office at (415) 974-7472.

Sincerely,

William D. Wilson
Chief, Technical Assessment Section
Toxics and Waste Programs Branch

cc: Terry Yonkers, Edwards AFB
Bill Haige, DOHS, Fresno
Tom Kovac, DOHS, Fresno

STATE OF CALIFORNIA GEORGE DEUKMEJIAN, Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD—
LAHONTAN REGION
2092 LAKE TAHOE BOULEVARD
P.O. BOX 9428
SOUTH LAKE TAHOE, CALIFORNIA 95731-2428

July 19, 1984

AFFTC/DEEV, STOP 210
ATTN: Terry Yonkers
Edwards AFB, CA 93523

RE: DRAFT REMEDIAL ACTION PLAN - INSTALLATION RESTORATION PROGRAM (IRP) AT EDWARDS AIR FORCE BASE (AFB).

Gentlemen:

We have reviewed the June 29, 1984 revisions of the Draft Remedial Action Plan (DRAP) for Phase IV of the IRP at Edwards AFB. We have no objections to the overall proposed DRAP, but we do wish to comment on several items in the plan.

1. Subsite IA - Motor Oil Disposal Trench

   a. The DRAP does not identify any criteria which would be used to determine when the site has been adequately cleaned up and no additional contaminated soil need be removed. The fuel-contaminated soil reportedly extends to a depth of 24 feet. Depending on the criteria used, enormous quantities of soil might be involved in a total clean-up operation at the site.

   b. Telephone communication with Terry Yonkers indicates that some contaminated soil would be left on site. Concentrations of fuels remaining in the soil should be documented.

2. Subsite 1C - Nitric Acid Pits and Subsite 1D - Drum Trenches

   a. The report does not indicate the thickness of the proposed synthetic liner to be used as part of the "cap" over the site. We recommend that the liner be at least 30 mils thick.

   b. Except for compaction, the report does not specify any procedures for installing the clay liner or any quality control program to ensure the construction of a good quality clay liner. Quality control tests for density, moisture content and permeability should be conducted in accordance with a predetermined schedule.

If you should have any questions, please contact Nelson Wong or Robert Dodds in our Victorville office at (619) 245-6583.

Very truly yours,

ROY C. HAMPSON
EXECUTIVE OFFICER

Robert S. Dodds

Robert S. Dodds
Senior Engineer

cvh
120-02